

Friends of the Great Salt Lake (FRIENDS) scope of work for project "Addressing air pollution inequities in the Salt Lake Valley through community-engaged particle monitoring"

FY 1: October 2022 - September 2023

Identify Community Concerns (Phase 1)

Collect input from community members to assess awareness and identify concerns and priorities

1. Design and produce marketing materials
 - Digital marketing toolkit for partners to share
 - Flyers and posters
 - Custom tablecloth for outreach events
 - FRIENDS budget does not cover cost for translation services
2. Recruit participants for listening and focus group sessions
 - FRIENDS members and supporters (e.g., email, social media)
 - FRIENDS partners (e.g., nonprofits, community councils)
 - Lakeside Learning Field Trip participants
 - Tabling at community events and high-traffic community locations (e.g., grocery stores, community centers, libraries)
3. Co-facilitate listening and focus group sessions with UDAQ staff or other project partners (offering light refreshments pending PO approval)
 - FRIENDS budget does not cover incentives for listening and focus group session participation

Deploy Sensors (Phase 2)

Identify and deepen key relationships to interpret community input, select sensor deployment sites, and inform engagement opportunities

1. Recruit and select community leaders to join steering committee
 - Committee reviews survey results and suggests how they should inform engagement opportunities and locations for air quality sensors
 - FRIENDS budget does not cover stipend/honorarium to committee members as compensation for their time and input
2. Recruit groups (e.g., local businesses, community organizations, church groups) to participate in education and volunteer events

Engage Communities (Phase 3)

Engage affected communities through education and volunteer events that empower and give residents the tools to be involved in monitoring their own air quality

1. In partnership with UDAQ staff, schedule and facilitate ~10 sensor installation events with volunteer groups recruited in Phase 2 (offering light refreshments pending PO approval)
2. Partner with schools and afterschool programs to implement education modules developed by the project team - either as standalone events or in tandem with hands-on sensor installation events

FY 2: October 2023 - September 2024

1. Continue Phase 3 activities involving sensors and educational modules
2. Highlight project at Spring 2024 Great Salt Lake Issues Forum

FY 3: October 2024 - September 2025

1. Continue Phase 3 activities involving sensors and educational modules

FOGSL budget table

Line Item & Itemized Cost	EPA funding
Personnel	
Education & Outreach Director @ \$20/hr x 450 hrs	\$9,000
Education Coordinator @ \$15/hr x 200 hrs	\$3,000
TOTAL PERSONNEL	\$12,000
Travel	
Mileage for staff: 2,500 mi x \$0.38/mi	\$950
TOTAL TRAVEL	\$950
Supplies	
Tablets for listening sessions and focus groups	\$1,000

Supplies for listening and focus group sessions and community events	\$2,500
Marketing materials	\$500
TOTAL SUPPLIES	\$4,000
TOTAL FUNDING	\$16,950

Understanding Particulate Matter in Levels Underserved Communities surrounding the Great Salt Lake

The proposed project will leverage existing state and community air quality monitoring networks and expertise to understand PM2.5 and PM10 sources in underserved communities around the Great Salt Lake. Several of the communities in this region have an EJ index in the 90th percentile or greater for PM2.5 and are predominantly low-income. These communities face growing air quality challenges including: the shrinking Great Salt Lake and associated fugitive dust as well as the development a new Inland Port and the accompanying transportation emissions. Existing monitoring in these underserved areas is geospatially sparse, and PM10 measurements are particularly limited.

Our goal is to partner with community organizations to:

- Understand their air quality concerns through community listening sessions, focus groups, and surveys.
- Understand how to make the measurements accessible and readily interpretable (see example below).
- Place additional monitors in the areas of greatest need and interest
- Provide expertise to communities to assist them in accessing and understanding the meaning of the measurements. This will include community and school outreach activities. Dr. Kelly has a strong track record of leading these activities.
- Provide the information and expertise needed to allow the community have meaningful impact on the decisions surrounding the development of the Inland Port and preservation of water levels in the Great Salt Lake.

The technical team's goal is to provide:

- Accurate, real-time estimates of particulate matter levels (PM2.5 and PM10). This can be especially important at schools and for sporting events.
- Accurate particulate matter trends that can provide insight into the effect of construction activities changes in traffic associated with the Inland Port.
- Accurate particulate matter trends and their association with levels in the Great Salt Lake.
- Results that are clear, transparent, and easy to understand.

UCCC Tasks (As defined by the SOPO)					Proposed Budget		
Task #	Name	UCCC Work	Timeline (Years)	Total Funding	Admin - 25%	Lead- 50%	Support 25%
Task 1	Needs Assessment	Support the design and delivery of a collective needs assessment and in our community listening sessions;	Y1, Y2	\$ 2,500.00	\$625.00	\$1,250.00	\$625.00
Task 2	Education Materials	Co-developing educational materials;	Y2, Y3	\$ 1,500.00	\$375.00	\$750.00	\$375.00
Task 3	Develop Milestones and Action Plan with the EPA community port collaborative toolkit	Working through the EPA community port collaborative toolkit as we prioritize goals. Your participation is particularly welcome because you are an agency with decision-making influence and because of your expertise as we develop our action plan;	Y1, Y2	\$ 3,000.00	\$750.00	\$1,500.00	\$750.00
Task 4	Air Monitoring Site Assessment and Placement	Assisting in siting monitors in areas of greatest concern to the communities;	Y1, Y2, Y3	\$ 2,000.00	\$500.00	\$1,000.00	\$500.00
Task 5	Community Engagement through Survey and Outreach	Offering the project team the opportunity to engage with community members who would be interested in your surveying and outreach efforts	Y1, Y2, Y3	\$ 11,000.00	\$2,750.00	\$5,500.00	\$2,750.00
Task 6	Project Steering Committee	Serving on the project steering committee.	Y1, Y2, Y3	\$ 5,000.00	\$1,250.00	\$2,500.00	\$1,250.00
Total Funding				\$ 25,000.00	\$6,250.00	\$12,500.00	\$6,250.00

UCC Project Contacts & Rates				
Loaded Rates	Project Administrator	Description	Contact	Email
\$150/hour	Project Administrator	Will manage or supervise the overall deployment of project terms and supervise the	Tammie Bostick	tammie.bostick@utahcleancities.org
\$100/hour	Project Manager	Plans and designates project resources, prepares budgets, monitor progress, and	Kelly Barrett	kelly.barrett@utahcleancities.org
\$75/hr	Project Support	temporary or permanent organizational unit that provides a portfolio of services to	To be determined	uccc@utahcleancities.org
				Phone Number
				801-580-1922
				801-638-4132

Proposed Federal Funds by Budget Period	
BP 1	\$10,000
BP 2	\$10,000
BP 3	\$5,000
Total	\$25,000

Total Federal & Matching Funds	
Federal Funding	\$25,000
Match	\$0
Total	\$25,000

UTAH DAQ - EPA Project Proposal
Total Budget



Start Date: TBD

End Date: 36 months after start date

Duration: 3 Years		Years	Hours	Base Rate	Costs (\$)
EPA Work Plan					\$ 55,727.34
DIRECT LABOR (List each category separately)					
Tier 1			0	\$ 25.00	\$ -
Tier 2 - Seasonal Cal., Firmware, QA, FE Mods, PEA			208	\$ 40.00	\$ 8,320.00
Tier 3			0	\$ 60.00	\$ -
Tier 4 - Semi-annual SS CF Update (Cross Validation)		3	40	\$ 125.00	\$ 15,000.00
Tier 5			0	\$ 200.00	\$ -
Direct Labor Subtotal					\$ 23,320.00
Apply Fringe Rate				35%	\$ 4,662.00
Total Direct Labor					\$ 27,982.00
Other Direct Costs		Yrs	Qty	Unit Cost	
AirU Monitor			30	\$ 250.00	\$ 7,500.00
Replacement AirU Monitor		2	6	\$ 261.36	\$ 1,568.18
AirU+ Monitor			13	\$ 804.85	\$ 10,463.05
Replacement AirU+ Monitor		2	2	\$ 829.00	\$ 1,657.99
Pre-Deployment Laboratory Sensor Calibration			0	\$ 40.00	\$ -
Admin Data Access (1-5 users)		3	1	\$ 70.00	\$ 210.00
Map Overlay(s)			2	\$ 640.00	\$ 1,280.00
AirU Demo Kit (For Rentals)			0	\$ 250.00	\$ -
Data Access		3	0	\$ 5.00	\$ -
Shipping and Other			0	\$ 24.00	\$ -
Travel			0	\$ 2,000.00	\$ -
Total Other Direct Costs					\$ 22,679.22
Total Direct					\$ 50,661.22
Apply Overhead Rate				0%	\$ -
Subtotal					\$ 50,661.22
Apply Fee				10%	\$ 5,066.12
Total Cost					\$ 55,727.34

Scope of Work

1. AirU Air Quality Monitor

- 1.1. The purchase of each AirU Air Quality Monitor. This does not include monitors purchased for rental programs
- 1.2. Estimated 3 AirU monitors to be replaced each year due to failure

2. AirU[+] Air Quality Monitor

- 2.1. PM10 sensor hardware
- 2.2. Firmware per Monitor
 - 2.2.1. Write firmware to integrate new hardware into the existing AirU Air Monitor
- 2.3. Q/A and Development
 - 2.3.1. Integrate a new sensor into the existing AirU Air Quality Monitor and to ensure communication with the board and Tellus's backend infrastructure

3. Calibration

- 3.1. Seasonal In-Field Calibration

Collected measurements of raw PM, relative humidity, and temperature from the AirU Air Quality monitors colocated with ground-truth instruments, such as those at government monitoring sites, that measure PM2.5, ozone, PM10, relative humidity and temperature. On a quarterly basis, new PM correction factors are developed using the average calibrations of each of the co-located AirU monitors as well as PurpleAir monitors. These correction factors are applied to data retrieved from the API
- 3.2. Cross-validation of the maps

4. Data Visualization

- 4.1. Updated regional information is added to the existing infrastructure. This would include setting a new area boundary (in partnership with the team), gathering elevation maps, and applying our pollution estimate model to the region

Itemized Cost					EPA Funding		
Personnel					Estimated Hours	Hourly Rate	Cost
Scientist IV @ 38.07\$/hr x 130 hrs/year x 3 years					390	\$38.07	\$14,847
TOTAL PERSONNEL							\$14,847
Fringe Benefits					Rate	Base Amount	Cost
TOTAL FRINGE					58%	\$14,847	\$8,611
Travel					Rate/mile	Total Miles	Cost
In-State Travel to sampling sites/community events @ \$0.38/mi x 2500 mi					0.38	2500	\$950
TOTAL TRAVEL							\$950
Supplies					Cost Per Unit	# of Units	Cost
Tablets (for surveys, listening sessions...)					\$500	4	\$2,000
Participant Support Costs (stipends, incentives)							\$25,400
TOTAL SUPPLIES							\$27,400
Contractual					Cost		
Contract with Tellus inc. for sensors, automated QA, map visualizations, providing back-end support for sensor network, developing air quality alert system. See attached budget (Tellus_Budget.pdf)					\$55,727		
TOTAL CONTRACTUAL					\$55,727		
Other					Cost		
Subaward to the University of Utah for survey services (inc. translation), sensor calibration & deployment, data QA & analysis, outreach activities, managing project website & air quality alert notifications. Attached budget (UU_Budget.pdf).					\$131,676		
Subaward to Utah Clean Cities for community outreach & engagement activities. Attached budget (UCC_Budget.pdf).					\$25,000		
Subaward to Friends of the Great Salt Lake for outreach & community engagement activities. Attached budget (FRIENDS_Budget.pdf)					\$16,950		
Phones, building/site rental, LAN, building utilities, printing/photocopying					\$1,220		
TOTAL OTHER					\$174,846		
TOTAL DIRECT COSTS.					\$282,381		
Indirect Charges					Rate	Base Amount	Cost
TOTAL INDIRECT					12.78%	\$23,458.0	\$2,998
TOTAL FUNDING					\$285,379		
TOTAL PROJECT COST					\$285,379		

Salary	ABA (mo)	Effort	Year 1	Year 2	Year 3
K. Kelly (PI - UofU)	12,875	0.333	4,287	4,416	4,548
UG sociology students	-	0	6,000		
UU outreach students	2,800	1	2,800	2,884	2,971
UG students - engineerin	2,800	2.5	7,000	7,210	7,426
UG student - website anc	2,800	1	2,800	1,442	1,485
Graduate student - Soc	2750		16,500		
Graduate student - ChE	2,600	3	6,500	5,356	5,517
Benefits			5,746	3,323	3,423
Travel - mileage			3,439	1,463	1,170
Supplies			1,200	500	500
Tuition Benefit			2,445	1,956	1,956
Twillo text message services			75	225	450
Survey translation			1,000		
Address services			2,270		
Subaward		-			
Direct costs			62,062	28,775	29,446
IDC		0.1	5,962	2,682	2,749
Total budget			68,024	31,456	32,195

Total

13,252

6,000

8,655

21,636

5,727

16,500

17,373

12,492

6,071

2,200

6,357

750

1,000

2,270

120,283

11,393

131,676

BUDGET JUSTIFICATION

Salaries and Fringe Benefits:

We request 1/3 of a month per year of Dr. Kelly's salary for overseeing the University of Utah work including sensor laboratory and field calibration, sensor deployment, troubleshooting, participating in outreach activities/community engagement, working with the K-12 outreach teams, fabricate housings for the AirU+s, and managing the project's website. A chemical engineering graduate student will train the undergraduate students to calibrate sensors, perform the field calibrations, and perform data analysis. A graduate student in sociology will require 6 months to develop the survey and to oversee the student teams who are collecting the survey results. We request 2.5 months/year of undergraduate student labor to perform laboratory calibration, deploy sensors, assist community members deploy sensors, and assist with data analysis. We also request one month per year of undergraduate effort to develop outreach materials and to perform outreach visits to schools and community events, and one month in year 1 of undergraduate effort to develop the project website, implement the instant air quality alerts and 0.5 month/yr in years 2 and 3 to maintain this infrastructure. We also request \$6,000 in year 1 for undergraduate students to perform surveys (\$15/hr and 20 hr/week for 10 weeks). Salary inflation is estimated at 3% per year.

All funds requested for salaries are based on the employees' actual annual rate. Fringe benefit rates are requested at the University of Utah (UofU) provisional rates of 37% for fully benefitted faculty and staff and 10% for undergraduate students.

Tuition benefits:

Tuition benefits are charged for the graduate student in the college of engineering at a rate of \$978 per semester month.

Materials and Supplies:

Materials and supplies are requested to support the scope of work (\$1,200 in year 1, and \$500 in years 2 and 3). This includes calibration supplies (connectors, conductive tubing, Arizona road dust), housing supplies for the AirU+s, and mounting supplies for sensors (zip ties, extension cords). It also includes supplies for outreach activities.

Other:

We request \$1,000 in year one for translation of the survey into Spanish. We request \$2,270 in year one to obtain a random sample of addresses and phone numbers of community members in our study area. We also request funds to support the messaging for instant, location-specific air quality alert (\$75/yr1, \$225/yr2, and \$450/yr3). This is based on Twillo rates of \$0.0075 per text message sent.

Travel:

Mileage reimbursements are requested for Dr. Kelly, the students performing the surveys, the outreach students, the students installing sensors. Mileage is reimbursed at a rate of \$0.585/mi. We estimate costs at \$3,439, \$1,462, and \$1,170 in years 1, 2, and 3, respectively.

Direct Cost Summary:

In summary, the total direct costs for the proposed research are delineated as shown below:

Category	YEAR 1	YEAR 2	YEAR 3	TOTALS
Salaries and Benefits	51,634	24,631	25,370	101,635
Tuition benefit (no IDC)	2,445	1,956	1,956	6,357
Materials, Supplies, other	4,545	725	950	6,220
Travel	3,439	1,463	1,170	6,071

Indirect Costs:

The University of Utah F&A rate is applied on a modified total direct cost (MTDC) basis, using the approved rate for the UofU of with the Utah Division of Air Quality 10%. The F&A calculated for each project year is shown below in the table for "Total Cost Summary."

Total Cost Summary:

To summarize, the total costs (direct and indirect) for the proposed research are shown in the table below:

Category	YEAR 1	YEAR 2	YEAR 3	TOTAL
Direct Costs	62,062	28,775	29,446	120,283
F&A Indirect Costs	5,962	2,683	2,749	11,383
TOTALS	68,024	31,456	32,196	131,676

Preaward Compliance Review Report for All Applicants and Recipients Requesting EPA Financial Assistance

Note: Read Instructions before completing form.

I. A. Applicant/Recipient (Name, Address, City, State, Zip Code)

Name: Utah Department of Environmental Qualit

Address: 195 N 1950 W

City: Salt Lake City

State: UT: Utah

Zip Code: 84114

B. DUNS No. 8260010590000

II. Is the applicant currently receiving EPA Assistance? ☒ Yes ☐ No

III. List all civil rights lawsuits and administrative complaints pending against the applicant/recipient that allege discrimination based on race, color, national origin, sex, age, or disability. (Do not include employment complaints not covered by 40 C.F.R. Parts 5 and 7.)

None

IV. List all civil rights lawsuits and administrative complaints decided against the applicant/recipient within the last year that allege discrimination based on race, color, national origin, sex, age, or disability and enclose a copy of all decisions. Please describe all corrective actions taken. (Do not include employment complaints not covered by 40 C.F.R. Parts 5 and 7.)

None

V. List all civil rights compliance reviews of the applicant/recipient conducted by any agency within the last two years and enclose a copy of the review and any decisions, orders, or agreements based on the review. Please describe any corrective action taken. (40 C.F.R. § 7.80(c)(3))

None

VI. Is the applicant requesting EPA assistance for new construction? If no, proceed to VII; if yes, answer (a) and/or (b) below.

☐ Yes ☒ No

a. If the grant is for new construction, will all new facilities or alterations to existing facilities be designed and constructed to be readily accessible to and usable by persons with disabilities? If yes, proceed to VII; if no, proceed to VI(b).

☐ Yes ☐ No

b. If the grant is for new construction and the new facilities or alterations to existing facilities will not be readily accessible to and usable by persons with disabilities, explain how a regulatory exception (40 C.F.R. 7.70) applies.

VII. Does the applicant/recipient provide initial and continuing notice that it does not discriminate on the basis of race, color, national origin, sex, age, or disability in its program or activities? (40 C.F.R. 5.140 and 7.95)

☒ Yes ☐ No

a. Do the methods of notice accommodate those with impaired vision or hearing?

☒ Yes ☐ No

b. Is the notice posted in a prominent place in the applicant's offices or facilities or, for education programs and activities, in appropriate periodicals and other written communications?

☒ Yes ☐ No

c. Does the notice identify a designated civil rights coordinator?

☒ Yes ☐ No

VIII. Does the applicant/recipient maintain demographic data on the race, color, national origin, sex, age, or handicap of the population it serves? (40 C.F.R. 7.85(a))

☐ Yes ☒ No

IX. Does the applicant/recipient have a policy/procedure for providing access to services for persons with limited English proficiency? (40 C.F.R. Part 7, E.O. 13166)

☒ Yes ☐ No

- X. If the applicant is an education program or activity, or has 15 or more employees, has it designated an employee to coordinate its compliance with 40 C.F.R. Parts 5 and 7? Provide the name, title, position, mailing address, e-mail address, fax number, and telephone number of the designated coordinator.**

Larene Wyss, Human Resource Director, lwyss@utah.gov, phone 801-536-4284.
195 North 1950 West, 4th Floor
P.O. Box 144810
Salt Lake City, UT 84114-4810

- XI. If the applicant is an education program or activity, or has 15 or more employees, has it adopted grievance procedures that assure the prompt and fair resolution of complaints that allege a violation of 40 C.F.R. Parts 5 and 7? Provide a legal citation or Internet Address for, or a copy of, the procedures.**

www.csr.b.utah.gov

For the Applicant/Recipient

I certify that the statements I have made on this form and all attachments thereto are true, accurate and complete. I acknowledge that any knowingly false or misleading statement may be punishable by fine or imprisonment or both under applicable law. I assure that I will fully comply with all applicable civil rights statutes and EPA regulations.

A. Signature of Authorized Official

Ty L Howard

B. Title of Authorized Official

Deputy Director

C. Date

03/24/2022

For the U.S. Environmental Protection Agency

I have reviewed the information provided by the applicant/recipient and hereby certify that the applicant/recipient has submitted all preaward compliance information required by 40 C.F.R. Parts 5 and 7; that based on the information submitted, this application satisfies the preaward provisions of 40 C.F.R. Parts 5 and 7; and that the applicant has given assurance that it will fully comply with all applicable civil rights statutes and EPA regulations.

A. *Signature of Authorized EPA Official

B. Title of Authorized Official

C. Date

*** See Instructions**

Instructions for EPA FORM 4700-4 (Rev. 06/2014)

General. Recipients of Federal financial assistance from the U.S. Environmental Protection Agency must comply with the following statutes and regulations.

Title VI of the Civil Rights Acts of 1964 provides that no person in the United States shall, on the grounds of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance. The Act goes on to explain that the statute shall not be construed to authorize action with respect to any employment practice of any employer, employment agency, or labor organization (except where the primary objective of the Federal financial assistance is to provide employment). Section 13 of the 1972 Amendments to the Federal Water Pollution Control Act provides that no person in the United States shall on the ground of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under the Federal Water Pollution Control Act, as amended. Employment discrimination on the basis of sex is prohibited in all such programs or activities. Section 504 of the Rehabilitation Act of 1973 provides that no otherwise qualified individual with a disability in the United States shall solely by reason of disability be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance. Employment discrimination on the basis of disability is prohibited in all such programs or activities. The Age Discrimination Act of 1975 provides that no person on the basis of age shall be excluded from participation under any program or activity receiving Federal financial assistance. Employment discrimination is not covered. Age discrimination in employment is prohibited by the Age Discrimination in Employment Act administered by the Equal Employment Opportunity Commission. Title IX of the Education Amendments of 1972 provides that no person in the United States on the basis of sex shall be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity receiving Federal financial assistance. Employment discrimination on the basis of sex is prohibited in all such education programs or activities. Note: an education program or activity is not limited to only those conducted by a formal institution. 40 C.F.R. Part 5 implements Title IX of the Education Amendments of 1972. 40 C.F.R. Part 7 implements Title VI of the Civil Rights Act of 1964, Section 13 of the 1972 Amendments to the Federal Water Pollution Control Act, and Section 504 of The Rehabilitation Act of 1973. The Executive Order 13166 (E.O. 13166) entitled; "Improving Access to Services for Persons with Limited English Proficiency" requires Federal agencies work to ensure that recipients of Federal financial assistance provide meaningful access to their LEP applicants and beneficiaries.

Items "Applicant" means any entity that files an application or unsolicited proposal or otherwise requests EPA assistance. 40 C.F.R. §§ 5.105, 7.25. "Recipient" means any entity, other than applicant, which will actually receive EPA assistance. 40 C.F.R. §§ 5.105, 7.25. "Civil rights lawsuits and administrative complaints" means any lawsuit or administrative complaint alleging discrimination on the basis of race, color, national origin, sex, age, or disability pending or decided against the applicant and/or entity which actually benefits from the grant, but excluding employment complaints not covered by 40 C.F.R. Parts 5 and 7. For example, if a city is the named applicant but the grant will actually benefit the Department of Sewage, civil rights lawsuits involving both the city and the Department of Sewage should be listed. "Civil rights compliance review" means any review assessing the applicant's and/or recipient's compliance with laws prohibiting discrimination on the basis of race, color, national origin, sex, age, or disability. Submit this form with the original and required copies of applications, requests for extensions, requests for increase of funds, etc. Updates of information are all that are required after the initial application submission. If any item is not relevant to the project for which assistance is requested, write "NA" for "Not Applicable." In the event applicant is uncertain about how to answer any questions, EPA program officials should be contacted for clarification. * Note: Signature appears in the Approval Section of the EPA Comprehensive Administrative Review For Grants/Cooperative Agreements & Continuation/Supplemental Awards form.



EPA KEY CONTACTS FORM

OMB Number: 2030-0020
Expiration Date: 06/30/2024

Authorized Representative: *Original awards and amendments will be sent to this individual for review and acceptance, unless otherwise indicated.*

Name:	Prefix:	<input type="text"/>	First Name:	<input type="text" value="Ty"/>	Middle Name:	<input type="text"/>
	Last Name:	<input type="text" value="Howard"/>			Suffix:	<input type="text"/>
Title:	<input type="text" value="Deputy Director"/>					
Complete Address:						
Street1:	<input type="text" value="195 N 1950 W"/>					
Street2:	<input type="text"/>					
City:	<input type="text" value="Salt Lake City"/>	State:	<input type="text" value="UT: Utah"/>			
Zip / Postal Code:	<input type="text" value="84114"/>	Country:	<input type="text" value="USA: UNITED STATES"/>			
Phone Number:	<input type="text" value="801-536-4403"/>			Fax Number:	<input type="text"/>	
E-mail Address:	<input type="text" value="tyhoward@utah.gov"/>					

Payee: *Individual authorized to accept payments.*

Name:	Prefix:	<input type="text"/>	First Name:	<input type="text" value="Valerie"/>	Middle Name:	<input type="text"/>
	Last Name:	<input type="text" value="Warr"/>			Suffix:	<input type="text"/>
Title:	<input type="text" value="Financial Manager II"/>					
Complete Address:						
Street1:	<input type="text" value="195 N 1950 W"/>					
Street2:	<input type="text"/>					
City:	<input type="text" value="Salt Lake City"/>	State:	<input type="text" value="UT: Utah"/>			
Zip / Postal Code:	<input type="text" value="84114"/>	Country:	<input type="text" value="USA: UNITED STATES"/>			
Phone Number:	<input type="text" value="801-536-4447"/>			Fax Number:	<input type="text"/>	
E-mail Address:	<input type="text" value="deqfederalgrants@utah.gov"/>					

Administrative Contact: *Individual from Sponsored Programs Office to contact concerning administrative matters (i.e., indirect cost rate computation, rebudgeting requests etc).*

Name:	Prefix:	<input type="text"/>	First Name:	<input type="text" value="Craig"/>	Middle Name:	<input type="text"/>
	Last Name:	<input type="text" value="Silotti"/>			Suffix:	<input type="text"/>
Title:	<input type="text" value="Finance Director"/>					
Complete Address:						
Street1:	<input type="text" value="195 N 1950 W"/>					
Street2:	<input type="text"/>					
City:	<input type="text" value="Salt Lake City"/>	State:	<input type="text" value="UT: Utah"/>			
Zip / Postal Code:	<input type="text" value="84114"/>	Country:	<input type="text" value="USA: UNITED STATES"/>			
Phone Number:	<input type="text" value="801-536-4460"/>			Fax Number:	<input type="text"/>	
E-mail Address:	<input type="text" value="csilotti@utah.gov"/>					

EPA KEY CONTACTS FORM

Project Manager: *Individual responsible for the technical completion of the proposed work.*

Name: **Prefix:** **First Name:** **Middle Name:**

Last Name: **Suffix:**

Title:

Complete Address:

Street1:

Street2:

City:

State:

Zip / Postal Code:

Country:

Phone Number:

Fax Number:

E-mail Address:

Project Narrative File(s)

* Mandatory Project Narrative File Filename:

Add Mandatory Project Narrative File

Delete Mandatory Project Narrative File

View Mandatory Project Narrative File

To add more Project Narrative File attachments, please use the attachment buttons below.

Add Optional Project Narrative File

Delete Optional Project Narrative File

View Optional Project Narrative File

Other Attachment File(s)

* Mandatory Other Attachment Filename:

[Add Mandatory Other Attachment](#)

[Delete Mandatory Other Attachment](#)

[View Mandatory Other Attachment](#)

To add more "Other Attachment" attachments, please use the attachment buttons below.

[Add Optional Other Attachment](#)

[Delete Optional Other Attachment](#)

[View Optional Other Attachment](#)

BUDGET INFORMATION - Non-Construction Programs

OMB Number: 4040-0006
Expiration Date: 02/28/2022

SECTION A - BUDGET SUMMARY

Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. N/A	66.034	\$	\$	285,379.00	\$	285,379.00
2.						
3.						
4.						
5. Totals		\$	\$	285,379.00	\$	285,379.00

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Prescribed by OMB (Circular A -102) Page 1

SECTION B - BUDGET CATEGORIES

6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY				Total (5)
	(1)	(2)	(3)	(4)	
	N/A				
a. Personnel	\$ 14,847.00	\$	\$	\$	\$ 14,847.00
b. Fringe Benefits	8,611.00				8,611.00
c. Travel	950.00				950.00
d. Equipment					
e. Supplies	27,400.00				27,400.00
f. Contractual	55,727.00				55,727.00
g. Construction					
h. Other	174,846.00				174,846.00
i. Total Direct Charges (sum of 6a-6h)	282,381.00				\$ 282,381.00
j. Indirect Charges	2,998.00				\$ 2,998.00
k. TOTALS (sum of 6i and 6j)	\$ 285,379.00	\$	\$	\$	\$ 285,379.00
7. Program Income	\$	\$	\$	\$	\$

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SECTION C - NON-FEDERAL RESOURCES					
(a) Grant Program		(b) Applicant	(c) State	(d) Other Sources	(e)TOTALS
8.		\$	\$	\$	\$
9.					
10.					
11.					
12. TOTAL (sum of lines 8-11)		\$	\$	\$	\$

SECTION D - FORECASTED CASH NEEDS					
	Total for 1st Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
13. Federal	\$ 95,127.00	\$ 23,784.00	\$ 23,781.00	\$ 23,781.00	\$ 23,781.00
14. Non-Federal	\$				
15. TOTAL (sum of lines 13 and 14)	\$ 95,127.00	\$ 23,784.00	\$ 23,781.00	\$ 23,781.00	\$ 23,781.00

SECTION E - BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT					
(a) Grant Program		FUTURE FUNDING PERIODS (YEARS)			
		(b)First	(c) Second	(d) Third	(e) Fourth
16.	N/A	\$ 95,126.00	\$ 95,126.00	\$	\$
17.					
18.					
19.					
20. TOTAL (sum of lines 16 - 19)		\$ 95,126.00	\$ 95,126.00	\$	\$

SECTION F - OTHER BUDGET INFORMATION	
21. Direct Charges: 282,381	22. Indirect Charges: 2,998
23. Remarks: Current Indirect Rate is 12.78%	

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Application for Federal Assistance SF-424

* 1. Type of Submission:

- ☐ Preapplication
☒ Application
☐ Changed/Corrected Application

* 2. Type of Application:

- ☒ New
☐ Continuation
☐ Revision

* If Revision, select appropriate letter(s):

* Other (Specify):

* 3. Date Received:

03/24/2022

4. Applicant Identifier:

5a. Federal Entity Identifier:

5b. Federal Award Identifier:

State Use Only:

6. Date Received by State: 03/23/2022

7. State Application Identifier: UTG-220323010-ac

8. APPLICANT INFORMATION:

* a. Legal Name: Utah Department of Environmental Quality

* b. Employer/Taxpayer Identification Number (EIN/TIN):

87-6000545

* c. Organizational DUNS:

8260010590000

d. Address:

* Street1: 195 N 1950 W
Street2: PO Box 144810
* City: Salt Lake City
County/Parish:
* State: UT: Utah
Province:
* Country: USA: UNITED STATES
* Zip / Postal Code: 84114-4810

e. Organizational Unit:

Department Name:

Environmental Quality

Division Name:

Air Quality

f. Name and contact information of person to be contacted on matters involving this application:

Prefix: Dr. * First Name: Nancy
Middle Name:
* Last Name: Daher
Suffix:

Title: Environmental Scientist IV

Organizational Affiliation:

Division of Air Quality

* Telephone Number: 385-377-6017

Fax Number:

* Email: ndaher@utah.gov

Application for Federal Assistance SF-424

* 9. Type of Applicant 1: Select Applicant Type:

A: State Government

Type of Applicant 2: Select Applicant Type:

Type of Applicant 3: Select Applicant Type:

* Other (specify):

* 10. Name of Federal Agency:

Environmental Protection Agency

11. Catalog of Federal Domestic Assistance Number:

66.034

CFDA Title:

Surveys, Studies, Research, Investigations, Demonstrations, and Special Purpose Activities
Relating to the Clean Air Act

* 12. Funding Opportunity Number:

EPA-OAR-OAQPS-22-01

* Title:

Enhanced Air Quality Monitoring for Communities

13. Competition Identification Number:

Title:

14. Areas Affected by Project (Cities, Counties, States, etc.):

Add Attachment

Delete Attachment

View Attachment

* 15. Descriptive Title of Applicant's Project:

Addressing Air Pollution Inequities in the Salt Lake Valley through Community-Engaged Particle
Monitoring.

Attach supporting documents as specified in agency instructions.

Add Attachments

Delete Attachments

View Attachments

Application for Federal Assistance SF-424**16. Congressional Districts Of:*** a. Applicant * b. Program/Project

Attach an additional list of Program/Project Congressional Districts if needed.

Add Attachment

Delete Attachment

View Attachment

17. Proposed Project:* a. Start Date: * b. End Date: **18. Estimated Funding (\$):**

* a. Federal	<input type="text" value="285,379.00"/>
* b. Applicant	<input type="text" value="0.00"/>
* c. State	<input type="text" value="0.00"/>
* d. Local	<input type="text" value="0.00"/>
* e. Other	<input type="text" value="0.00"/>
* f. Program Income	<input type="text" value="0.00"/>
* g. TOTAL	<input type="text" value="285,379.00"/>

*** 19. Is Application Subject to Review By State Under Executive Order 12372 Process?**

- ☒ a. This application was made available to the State under the Executive Order 12372 Process for review on .
- ☐ b. Program is subject to E.O. 12372 but has not been selected by the State for review.
- ☐ c. Program is not covered by E.O. 12372.

*** 20. Is the Applicant Delinquent On Any Federal Debt? (If "Yes," provide explanation in attachment.)**☐ Yes ☒ No

If "Yes", provide explanation and attach

Add Attachment

Delete Attachment

View Attachment

21. *By signing this application, I certify (1) to the statements contained in the list of certifications and (2) that the statements herein are true, complete and accurate to the best of my knowledge. I also provide the required assurances** and agree to comply with any resulting terms if I accept an award. I am aware that any false, fictitious, or fraudulent statements or claims may subject me to criminal, civil, or administrative penalties. (U.S. Code, Title 218, Section 1001)**

☒ ** I AGREE

** The list of certifications and assurances, or an internet site where you may obtain this list, is contained in the announcement or agency specific instructions.

Authorized Representative:

Prefix: * First Name:

Middle Name:

* Last Name:

Suffix:

* Title: * Telephone Number: Fax Number: * Email: * Signature of Authorized Representative: * Date Signed:



UTAH DEPARTMENT of
ENVIRONMENTAL QUALITY
**AIR
QUALITY**

MEMORANDUM

To: *Executive Director's Office*

From: *Bryce C. Bird, Air Quality Director* ~~*B.C.B.*~~
BB

Date: *3/23/2022*

Subject: *2022 Addressing Air Pollution Inequities in the SL Valley Through
Community-Engaged Particle Monitoring Grant – Workspace
#WS00850874*

Amount: *\$285,379*

UDAQ is committed to safeguarding and improving Utah's air through balanced regulation. Current projects include the development of O3 SIP and ambient monitoring/health risk assessment of ethylene oxide from medical sterilizers. A summer-time ambient monitoring O3 study is also being planned with NOAA, EPA and local researchers. This grant will enhance PM_{2.5} and PM₁₀ monitoring in underserved communities by integrating low-cost particle measurements with community partnerships. Air Quality will engage communities through our community steering committee, community meetings, surveys and listening sessions, outreach modules, and air quality visualizations and alerts. This work will help strengthen relationships between impacted communities and regulatory agencies, leading to increased trust, effective collaboration and shared decision-making.

A. Quality Assurance Statement

1. QA/QC Management

Dr. Daher and Dr. Kelly will be responsible for quality assurance and control (QA/QC). They are experienced air quality researchers with extensive experience collecting, validating and processing large sets of field data. They have led multiple field campaigns and authored numerous peer-reviewed papers. Dr. Kelly has extensive experience in low-cost sensors (LCSs), with an emphasis on PM and data quality^[1-4]. Dr. Daher will focus on the LCS site selection and the co-location with the FEM/FRMs while Dr. Kelly will focus on validating the AirU⁺ (Plantower PMS for PM_{2.5} + Alphasense OPC N3 for PM_{2.5}/PM₁₀) and PurpleAir (PA, Plantower PMS for PM_{2.5}). Standard operating procedures will be developed to ensure consistency in sensor operation/placement and data collection. The researchers will also consult with UDAQ's QA officers, as needed.

2. Project and Quality Objectives

Data and validation is key to achieving our performance objectives. This project leverages three existing sensor networks (UDAQ, AirU/Tellus, and PA) to provide neighborhood-scale estimates of PM_{2.5} and PM₁₀. We plan a multilayered approach to validate sensor performance and the PM concentration estimates. This includes laboratory evaluation, correction factors for the non-FEM (PA/AirU) measurements, data screening, map validation, and transparent data processing/access.

3. Measurement validation

Dr. Daher will follow DAQ QA procedures for their monitors, and Dr. Kelly will follow EPA guidance for performance of PM sensors^[5-7].

3.1 DAQ monitors. Data from DAQ monitors are reviewed and validated by DAQ QA officers following strict EPA guidelines, using established measurement and data quality objectives.

3.2 Sensor Pre-deployment. All AirU (including AirU⁺OPC) sensors deployed as part of this project will be of the same make and model type and have the same firmware. Prior to field deployments, all AirU and AirU⁺ sensors will be calibrated with a 5-point calibration curve in Dr. Kelly's calibration chamber (PM_{2.5}: 5 - 150 µg/m³ and PM₁₀: 10 - 300 µg/m³).^[2] The objective is to avoid deploying any sensor that exhibits a coefficient of variation > than 30%.^[5]

3.3 Sensor correction factors. Optical particle counters and nephelometers require a correction factor to convert particle counts and light scattering, respectively, to particle mass concentrations. Seasonal and event-specific (i.e., dust events) factors will be developed for AirU⁺ (PM_{2.5} and PM₁₀) and PA (PM_{2.5}). Dr. Kelly will co-locate three PAs (PMS 5003), and three AirU⁺s (PMS 3003 + Alphasense OPC N3) at UDAQ's future Beck St. monitoring station, equipped with a Teledyne T640 (hourly PM₁₀ and PM_{2.5} and complete meteorological measurements). This site is located downwind of a portion of dry Great Salt Lake bed, near a roadway frequented by heavy-duty vehicles, and near a gravel operation. The LCSs will have unrestricted air flow and will be placed within 10 m (horizontal) and 1 m (vertical) of T640 inlet, and 1 m away from each other. All co-located LCSs (AirU⁺ and PA (PMS) that meet the data completeness criteria (75%^[5]) will be used to develop seasonal calibration factors. For the past four years, Dr. Kelly has maintained three PA IIs and three AirUs at UDAQs Hawthorne site and has demonstrated that, after applying seasonal correction factors, AirU and PAs meet EPA's performance targets (Table ES2)^[5] when seasonal mean PM_{2.5} concentrations exceed 5 µg/m³.^[3,4]

3.4 Sensor siting. LCSs deployment will follow EPA recommendations^[7]. Briefly, they will be placed 6 ft above the ground or rooftop level, away from non-representative emission sources (i.e.,

dryer vents, grills, etc.), with at least 180° of unobstructed flow, and if placed on a building it will be placed on the upwind side. The team will take detailed notes regarding the site and photographs of the installations^[7], and place these in our electronic log books.

3.5 Screening. LCS readings (AirU+, PA) will be screened using the following automated procedure. (1) All sensors located indoors are excluded (i.e., specified as indoor or exhibiting an indoor temperature profile). (2) Individual measurements exceeding 1,000 $\mu\text{g}/\text{m}^3$ ($\text{PM}_{2.5}$) or 5,000 $\mu\text{g}/\text{m}^3$ (PM_{10}) are flagged. (3) Sensors that measure 0 $\mu\text{g}/\text{m}^3$ for the past 24 hours are flagged. (4) If sensor nodes contain more than one sensor, the measurements are averaged when they agree within 15% or the average of the sensors exceeds 5 $\mu\text{g}/\text{m}^3$. Otherwise, both sensors are flagged. (5) We compare $\text{PM}_{2.5}$ or PM_{10} measurements against the median deviation for their respective measurements in the same geographic area over 8-minute intervals. Thus, each sensor's median value ($\text{PM}_{2.5}$ or PM_{10}) over the interval, and the median and median deviations are computed for that geographic area. Measurements that differ from the median by more than 10x the median deviation are flagged. In addition, drift is evaluated on a quarterly basis by examining time periods when PM levels are low^[8] (FEM/FRM $\text{PM}_{2.5}/\text{PM}_{10}$ levels below 5 and 10 $\mu\text{g}/\text{m}^3$, respectively, concentrations selected based on LCS performance, precision of FEMs, and at least 20% of FEM measurements during a season meeting the criteria). If a sensor's median $\text{PM}_{2.5}$ or PM_{10} concentration during the low concentration periods exceeds 5 or 10 $\mu\text{g}/\text{m}^3$, they are flagged. These flagged measurements are not removed from the database but they are excluded from the $\text{PM}_{2.5}$ and PM_{10} estimate maps. Poorly functioning sensors can be replaced.

3.6 Validation of $\text{PM}_{2.5}$ and PM_{10} maps. On a quarterly basis, Dr. Kelly and Tellus will validate the Gaussian Process (GP) PM estimates, presented in the community dashboard, using a leave-one-out cross-validation at two randomly selected UDAQ monitoring stations that measure $\text{PM}_{2.5}$ and PM_{10} (sites may differ for $\text{PM}_{2.5}$ and PM_{10}). They have demonstrated the accuracy of their estimate maps using the leave-one-out cross validation approach.^[4]

4. Data Management

All sensor data (GPS coordinates, temperature, relative humidity, raw Plantower $\text{PM}_{2.5}$ concentration, Alphasense PM particle size distribution) at 2 minute intervals will be stored in Google Cloud (regularly backed up). The correction factors (and applicable dates) will be publicly available. Data can be accessed through a public API. Field logbooks will be maintained with details about sensor siting, nearby sources, and WiFi connectivity^[7]. Each morning, Drs. Daher and Kelly receive a network health report that provides key metrics, such as measurement sources (AirU, UDAQ, PA), time series measurements, and any flagged measurements. Corrective measures, i.e., site inspections, sensor replacement, will be taken as needed.

References

- [1] Kelly, K. Ambient and laboratory evaluation of a low-cost particulate matter sensor. *Env. Poll.* 2017.
- [2] Sayahi, T. Development of a calibration chamber to evaluate the performance of low-cost particulate matter sensors. *Env. Poll.* 2019.
- [3] Sayahi, T. Long-term field evaluation of the Plantower PMS low-cost particulate matter sensors. *Env. Poll.* 2019.
- [4] Kelly, K. Community-Based Measurements Reveal Unseen Differences during Air Pollution Episodes. *Env. Sci. Technol.* 2021.
- [5] Duvall, R. Performance Testing Protocols, Metrics, and Target Values for Fine Particulate Matter Sensors; 2021.
- [6] Duvall, R. Deliberating Performance Targets: Follow-on workshop discussing PM_{10} , NO_2 , CO, and SO_2 air sensor targets. *Atmos. Environ.* 2021.
- [7] US-EPA. A Guide to Siting and Installing Air Sensors <https://www.epa.gov/air-sensor-toolbox/guide-siting-and-installing-air-sensors> (accessed Feb 21, 2022).
- [8] Tsujita, W. et al. Gas sensor network for air-pollution monitoring. *Sensors Actuators, B Chem.* 2005, 304–311.

BIOGRAPHICAL SKETCH

NAME: Nancy Daher

POSITION TITLE: Air Quality Modeler and Researcher, Utah Division of Air Quality (UDAQ)
Adjunct Assistant Professor, Family and Preventive Medicine, University of Utah

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE	Completion Date	FIELD OF STUDY
Notre Dame University	B.E.	02/2007	Mechanical Engineering
American University of Beirut	M.E.	06/2009	Mechanical Engineering
University of Southern California	Ph.D.	12/2013	Environmental Engineering

A. Personal Statement

My research work is at the intersection of air quality, personal health exposure assessment and atmospheric chemistry. I have expertise in the areas of air pollution monitoring, air toxics, source apportionment, particle physico-chemical characterization and redox activity, and air quality modeling. For the past several years, my work has been solely focused on understanding air quality challenges in the Salt Lake Valley (SLV). This includes using both measurement and modeling techniques to characterize local air pollution emission sources and their contribution to air toxics, PM/O₃ formation in the valley. I have led and participated in multiple air monitoring studies, several of which were collaborations with co-PI Kerry Kelly and two of which were awarded by the EPA. I am also the lead photochemical modeler for UDAQ. Through this work, I developed a strong understanding of source emissions and air quality challenges in the valley, and robust ties with the local communities. I will leverage these connections and draw upon my experience in monitoring and knowledge of air quality in the SLV for the proposed project.

B. Positions and Employment

2016 - present Adjunct Assistant Professor, Family and Preventive Medicine, University of Utah
Jan. 2015 - present Air Quality Modeler and Researcher, Utah Division of Air Quality
2013 - 2014 Postdoctoral Scholar, University of Southern California

C. Contribution to Science

My research work resulted in 32 peer-reviewed publications, including a publication in Nature's Scientific Reports, and over 2668 citations. **Link to citations:** <https://tinyurl.com/ycbckz6k>

SELECTED RESEARCH WORK RELEVANT TO THIS APPLICATION

Air quality monitoring, community exposure and engagement – My research work has been focused on determining the sources, spatio-temporal variation of air toxics, associated exposure risk and implications on environmental justice. This includes exploring low-cost sensors for continuous measurement of formaldehyde and conducting saturation monitoring, which predominantly relied on volunteer community hosts, and assistance from local health departments and cities. Work also included community outreach, and results dissemination to air quality advocacy groups and local health departments. I will use knowledge gained from these studies to design the air quality sampling component of the study. Community connections built through my past work will also be leveraged for the proposed project.

- N. Daher**, R. Edie, R. Handy. Canister-based risk assessment of ethylene oxide from two commercial sterilization facilities in the SLV (ongoing; CSATAM Award #XA-96861401).
- N. Daher**, **K. E. Kelly**. Saturation monitoring of air toxics in Davis County, Utah: <https://documents.deq.utah.gov/air-quality/planning/technical-analysis/DAQ-2020-005424.pdf>
- N. Bhardwaj, A. Kelsch, D. J. Eatough, R. Thalman, **N. Daher**, **K.E Kelly**, I. C. Jaramillo, J. C. Hansen. Sources of formaldehyde in Bountiful, Utah, Atmosphere, 12(3), 375, 2021.

Air pollution emission sources, implications on environmental justice– My research work also focuses on understanding local air pollution emission sources and their contributions to PM, ozone and air toxics formation in the valley. This is accomplished through air quality monitoring, photochemical modeling, trajectory modeling and use of source attribution techniques. I will use knowledge gained from this work to inform sensor siting, identify communities with highest PM priority concerns, and analyze and interpret the collected measurements.

- a) N. Bhardwaj, A. Kelsch, D. J. Eatough, R. Thalman, **N. Daher, K.E Kelly**, I. C. Jaramillo, J. C. Hansen. Sources of formaldehyde in Bountiful, Utah, Atmosphere, 12(3), 375, 2021.
- b) **N. Daher, K.E Kelly**, I. C. Jaramillo. Wood-burning emissions, their spatial variation and contribution to PM_{2.5} in the Salt Lake valley.
<https://deq.utah.gov/air-quality/understanding-how-wood-burnings-contribution-to-particulate-matter-concentrations-have-changed-over-time>
- c) **N. Daher**, C. Pennell. Air Quality Modeling of a Typical Wintertime PM_{2.5} Pollution Event in Cache Valley, Utah: Implications for emission control strategies, 18th CMAS conference, 2019.
- d) **N. Daher**, C. Pennell. Predicting the impact of a wood-stove change-out program on ambient particle levels in Utah's airshed, 16th CMAS conference, 2016.
- e) Wasatch Front PM_{2.5} Attainment Demonstration. Role: Main photochemical modeler.
<https://deq.utah.gov/air-quality/pm2-5-salt-lake-city-maintenance-plans-technical-support-documents>
- f) Northern Wasatch Front O₃ Attainment Demonstration (ongoing). Role: Main photochemical modeler

Other Select Publications

- g) S. Hasheminassab, **N. Daher**, A. Saffari, D. Wang, B. D. Ostro, C. Sioutas. Spatial and temporal variability of sources of ambient fine particulate matter (PM_{2.5}) in California. Atmospheric Chemistry and Physics, 14, 12085-12097, 2014.
- h) S. Hasheminassab, **N. Daher**, B. D. Ostro, C. Sioutas. Long-term source apportionment of ambient fine particulate matter (PM_{2.5}) in the Los Angeles basin: a focus on emissions reduction from vehicular sources. Environmental Pollution, 193, 54-64, 2014.
- i) S. Hasheminassab, **N. Daher**, M. M. Shafer, J. J. Schauer, R. J. Delfino, C. Sioutas. Chemical characterization and source apportionment of indoor and outdoor fine particulate matter (PM_{2.5}) in retirement communities of the Los Angeles Basin. Science of the Total Environment, 490, 528-537, 2014.

D. Research Support

Ongoing Research Support

2021-2023 Community-scale Air Toxics Ambient Monitoring, \$328,459, Environmental Protection Agency (PI)
Goal: Monitoring and health risk assessment of ethylene oxide emissions from sterilizers in Utah

Completed Research Support

2018-2022 Targeted Airshed Grant (non-research), \$9,600,000, Environmental Protection Agency (co-PI)
"Implementation of a wood-stove change-out program in Utah's valleys"

2018-2020 Community-scale Air Toxics Ambient Monitoring, \$330,765, Environmental Protection Agency (PI)
"Evaluation of low-cost sensors for continuous measurement of formaldehyde".

2016-2017 Multipurpose Grant, \$191,642, Environmental Protection Agency (PI)
"Source identification and measurement of air toxics near industries and refineries in Davis County, Utah"

2015-2017 FY15 Utah State Legislature, \$20,000 (PI)
"Quantifying the contribution of residential wood-burning to winter-time PM_{2.5} levels in Utah's valleys and 2)
Predicting the effect of a wood-stove change-out program on reducing these winter-time PM_{2.5} levels".

E. Collaborations

2019-2020 Collaborator with US Forest Service and Utah State University. "Measurement of PM_{2.5} emissions from prescribed fire burns under different atmospheric conditions"

2019 Collaborator with **Utah Department of Health (partner on proposed project)**- "Determining PM₁₀ levels and exposure in local communities proximate to gravel operations"

2018-2019 FY18 Utah State Legislature, collaborator with Utah State University, the University of Utah and Brigham Young University. "Measurement and source identification of ammonia emissions along Utah's Wasatch Front"

2018-2019 FY18 Utah State Legislature, collaborator with Brigham Young University and the University of Utah. "Real-time measurement and source apportionment of VOCs in Bountiful, UT"

2018-2019 FY18 Utah State Legislature, collaborator with the University of Utah. "Real-time measurements of wood-burning emissions & determination of the compliance rate with wood-burning ban on high air pollution days"

2019 Collaborator with the Environmental Protection Agency. "Mobile monitoring of ammonia levels along the Wasatch Front and in Cache Valley"

2018 Pilot study, Collaborator with the University of Utah. "Assessing students' exposure to ozone during school recess"

BIOGRAPHICAL SKETCH

NAME: Kerry E Kelly

POSITION TITLE: Associate Professor, Chemical Engineering, University of Utah

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE	Completion Date	FIELD OF STUDY
Purdue University	B.S.	12/1988	Chemical Engineering
University of North Carolina, Chapel Hill	M.S.	05/1992	Environmental Engineering
University of Utah	Ph.D.	05/2015	Environmental Engineering

A. Personal Statement

My work focuses on the links between energy, air quality and human health, with a particular emphasis on aerosol formation, characterization and health effects. The Wasatch Front, the home of the University of Utah, periodically experiences some of the worst air quality in the country, and our region's air quality challenges motivate much of my research. I have served 8 years on the State Air Quality Board and currently serve on the State Air Quality Policy Board, which allows me to help translate science into air-quality policy. In 2018, I was awarded the UCAIR air quality person of the year by the governor for my service to the state. I also serve on the boards of UCAIR (the Utah Clean AIR partnership) and Breathe Utah (a non-profit organization that emphasizes education and practical solutions to our region's air quality challenges). My role in this project builds on my extensive experience in aerosol measurement techniques and low-cost sensing.

B. Positions and Employment

1994-1996	Scientist, Fraunhofer Institute for Atmospheric Environmental Research, Garmisch-Partenkirchen, Germany.
1996-2000	Research Engineer, Center for Clean Products and Clean Technologies, University of Tennessee, Knoxville, TN.
2000-2010	Research Engineer, Institute for Combustion & Energy Studies, University of Utah, Salt Lake City, UT.
2014-pres.	Associate Director, University of Utah Program for Air Quality, Health and Society, University of Utah, Salt Lake City, UT.
2015-2021	Assistant Professor, Department of Chemical Engineering, University of Utah, Salt Lake City, UT.
2021-pres	Associate Professor, Department of Chemical Engineering, University of Utah, Salt Lake City, UT.

C. Contribution to Science

List of published work in Google scholar

<https://scholar.google.com/citations?user=cILti4sAAAAJ>

SELECTED RESEARCH WORK RELEVANT TO THIS APPLICATION

Low-cost, air-quality sensing. Because of the region's air quality challenges, I partnered with researchers in Electrical Engineering and Computer Science to develop a community-engaged network of air-quality sensors, and we developed cost-effective, air-quality sensing solutions, an understanding sensor performance, and strategies to integrate measurements from different sources and of different qualities to present engaging, real-time, neighborhood-scale pollution maps

- a) **K.E. Kelly**, W. Xing, P. Goffin, T. Sayahi, T. Becnel, A. Biglari, P.-E. Gaillardon, A. E. Butterfield, M. Meyer, R.T. Whitaker (2021) Community-based measurements reveal unseen differences during air-pollution episodes. *Environmental Science & Technology*. 2021, 55, 1, 120–128.

- b) T. Becnel, K. Tingey, J. Whitaker, T. Sayahi, K. Le, P. Goffin, A. Butterfield, **K.E. Kelly**, P.-E. Gaillardon (2019) A distributed low-cost pollution monitoring platform. 6(6) 10738-10748 *Internet of Things Journal*.
- c) T. Sayahi, D. Kaufman, T. Becnel, K. Kaur, A. Butterfield, S. Collingwood, Y. Zhang, P.-E. Gaillardon, **K.E. Kelly** (2019) Development of a calibration chamber to evaluate the performance of low-cost particulate matter sensors, *Environmental Pollution*. 255, 113131.
- d) T. Sayahi, A. Butterfield, **K.E. Kelly** (2019) Long-term field evaluation of the Plantower PMS low-cost particulate matter sensors, *Environmental Pollution*, 245, 932-940.

Understanding environmental inequities – My research work also focuses on understanding the spatio-temporal variation in air quality and the environmental justice implications. This work leverages my group's expertise in low-cost sensing networks as well source attribution techniques.

- a) E. Chadwick, K. Le, Z. Pei, T. Sayahi, A. Butterfield, **K.E. Kelly** (2021) Using a Low-cost Sensor Network to Understand the Effect of COVID-19 on Particle Pollution. *Journal of Aerosol Science*. 155, June, 105766.
- b) C. Mullen, S. Grineski, T. Collins, W. Xing, R. Whitaker, T. Sayahi, T. Becnel, P. Goffin, P.-E. Gaillardon, M. Meyer, **K.E. Kelly** (2020) Patterns of distributive environmental inequity under different PM_{2.5} air pollution scenarios for Salt Lake County public schools. *Environmental Research*. 186 109543.
- c) N. Bhardwaj, A. Kelsch, D. J. Eatough, R. Thalman, **N. Daher**, **K.E. Kelly**, I. C. Jaramillo, J. C. Hansen. Sources of formaldehyde in Bountiful, Utah, *Atmosphere*, 12(3), 375, 2021.

Air quality, community engagement, and educational outcomes – My group's work developing hands-on outreach activities has led to local and national press coverage, a demonstration at the National Science Fair and Expo in 2019, two AIChE best student outreach awards, and one best paper award. Annually, I give more than 25 presentations to community groups and schools to discuss local air quality challenges and potential solutions.

- a) J. Moore, M. Dailey, Z. Wilhelm, **K.E. Kelly**, P. Goffin, J. Wiese, W. Xing, K.M. Le, T. Becnel, P.-E. Gaillardon, A.E. Butterfield (2020) Engaging pre-college students in hypothesis generation using a citizen scientist network of air quality sensors. *Proc. ASEE Annual Meeting*, K-12 Education Session.
- b) K. Le, T. Butterfield, T. Becnel, P.-E. Gaillardon, **K.E. Kelly** (2018) Citizen scientist engagement in air quality monitoring, *Proc. ASEE Annual Meeting*, June 23 – 27, Salt Lake City, UT.
- c) K. Le, K. Tingey, T. Becnel, P. Gaillardon, T. Butterfield, **K.E. Kelly** (2018) Building air quality sensors & inspiring citizen scientists, *Chemical Engineering Education*, 52, 3, 193-201. **William H. Corcoran Award for the best paper in Chemical Engineering Education in 2019.**

An underline denotes my students, and italicized and underlined indicates an undergraduate student mentee

D. Ongoing Research Support

NSF CAREER: Community-Engaged, Sensor Network for Identifying Air Pollution Sources (PI)

7/01/2020 – 6/31/2025

NIH Linking Combustion-Derived Particle Physicochemical Properties to Pathologically Important Responses in Lung Cells (PI)

01/01/2017-12/31/2022

NSF Smart and Connected Communities: Informing Transportation Decision Making through Innovative Sensing, Data Analytics and Feedback (PI)

10/2020 – 9/2023

NSF Critical zone observations in the Intermountain West (col)

10/2020 – 9/2025

NIH A Multicity Study of Wintertime Inversions and Acute Cardiorespiratory Health Events in the Western U.S. (col)

4/2021 – 3/2026

BIOGRAPHICAL SKETCH

NAME: Sara Elizabeth Grineski

POSITION TITLE: Professor of Sociology and Environmental & Sustainability Studies

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE	Completion Date	FIELD OF STUDY
Concordia College, Moorhead, MN USA	B.A.	05/2001	Sociology, Biology
Arizona State University, Tempe, AZ USA	M.A.	05/2003	Sociology
Arizona State University, Tempe, AZ USA	Ph.D.	05/2006	Sociology, Geography minor

A. Personal Statement

I am well-suited to collaborate on this project as the co-lead on the survey research element of the work. I have extensive research experience related to air quality, environmental justice and survey research methods, as evidenced by my published work and previous research grants. My doctoral training in an interdisciplinary environment and my past and current collaborations with scholars from diverse disciplines have prepared me well for this project, which integrates multiple academic disciplines. I am an experienced mentor of graduate and undergraduate students, having mentored >60 research students over the last 14 years, making me well-prepared to oversee the student that will assist with the survey. In addition, I co-direct the Center for Natural and Technological Hazards at the University of Utah and serve as an appointed member of the EPA (Office of Research and Development) Board of Scientific Counselors, Social and Community Science Subcommittee.

I will provide summer funding for one graduate student and two undergraduate students through the National Institutes of Environmental Health Sciences R25 summer research program for undergraduate students from underrepresented racial/ethnic backgrounds that I co-direct with Collins (called HAPPIEST). This program supports students for 10 weeks to work on air quality research full-time. We will allocate one of the four Summer 2023 teams to this work.

I have co-led numerous environmental justice/environmental health projects involving social survey development, implementation and analysis, including three projects funded by the National Science Foundation and one funded by the National Institutes of Health. Four publications based on primary survey data that my team has collected are listed below as examples:

1. **Grineski, S.E.**, **Flores, AB., Collins, T.W., Chakraborty, J. 2020. The impact of Hurricane Harvey on Greater Houston Households: Comparing pre-event preparedness with post-event health effects, exposure experiences and recovery. *Disasters*. 44(2): 408-432.
2. **Grineski, SE**, Collins, TW, Chakraborty, J, **Montgomery, M. 2017. Hazard characteristics and patterns of environmental injustice: household-level determinants of environmental risk in Miami, Florida. *Risk Analysis*. 37(7): 1419–1434.
3. **Grineski, SE**, Collins, TW, **Kim, YA. 2016. Contributions of individual acculturation and neighborhood ethnic density to variations in Hispanic children's respiratory health in a U.S.-Mexican border metropolis. *Journal of Public Health*. 38(3): 441-449. (PMID: 26124235)
4. **Grineski, SE**, **Clark-Reyna, S, Collins, TW. 2016. School-based exposure to hazardous air pollutants and grade point average: a multi-level study. *Environmental Research*. 147: 164-171. (PMID: 26875067)

B. Positions, Scientific Appointments, and Honors

Positions and Employment

- 2/2022-2025. Member, Board of Scientific Counselors, Social and Community Science Subcommittee, U.S. Environmental Protection Agency, Office of Research and Development, Durham, NC.
- 3/2021-present. Co-Director. HAPPIEST NIEHS R25. University of Utah, UT.
- 1/2020-present. Director. Undergraduate Studies. Sociology. University of Utah, UT.
- 8/2018-present. Co-Director. Center for Natural and Technological Hazards. University of Utah.
- 1/2018-present. Professor of Sociology, Department of Sociology, with a joint appointment in Environmental and Sustainability Studies, University of Utah, Salt Lake City, UT.
- 9/2016-12/2017. Director. Sociology Graduate Program. University of Texas at El Paso, TX.

- 6/2014-12/2017. Director. Research Enrichment Core of the NIH BUILDing SCHOLARS Center. NIH Diversity Program Consortium. University of Texas at El Paso, TX.
- 8/2006-12/2017. Faculty Member, Department of Sociology and Anthropology, University of Texas at El Paso, El Paso, TX.
- 9/2011-2014. Director. Environment Core of the Hispanic Health Disparities Research Center, a NIMHD-EPA Center of Excellence in Environmental Health Disparities. University of Texas at El Paso and University of Texas at Houston, School of Public Health. El Paso, TX.

Other Experiences and Professional Memberships

- 2018-present. Solutions Scholars Faculty Advisor, Steering Committee Member and Student Selection Committee Member. College of Social and Behavioral Science. University of Utah.
- 2016-2020. Environmental Justice Advisory Board Member. Union of Concerned Scientists.
- 2015-2017. Coordinator. For a summer research program placing over 100 undergraduate students with faculty mentors across 13 research institutions, including University of Texas at El Paso, as part of BUILDing SCHOLARS.
- 2015-2017. Faculty Liaison. *Familias Unidas de Chamizal*. Environmental Justice community group in El Paso, TX.
- 2008-2017. Thesis Supervisor. Sociology Master's Program. Chaired 17 committees (also served on 15 committees). University of Texas at El Paso.
- 2007-present. Undergraduate Research Mentor. Mentored 27 students on research projects.
- 2001-2006. Doctoral Fellow in the Integrative Graduate Education and Research Traineeship (IGERT) program in Urban Ecology funded by the National Science Foundation.

C. Contributions to Science

***denotes undergraduate student author, **graduate student author, and *post-doctoral author

- 1. Pollution, schools, and children's intellectual development:** The problem of environmental health hazards around schools is serious but it has been neglected by researchers and analysts. This is concerning because children are highly susceptible to the effects of chemical hazards. One documented consequence of school-based exposure to environmental health hazards is a reduction in children's aggregate standardized test scores. While documenting a disturbing pattern, this extant literature is limited by ecological study designs. Improving on prior school-level studies, my team and I have used individual-level data to quantify the impact of pollution on children's GPA (a-c). We have also conducted the first national studies of social inequalities in exposure to noise pollution at US elementary (d).
 - a. **Clark-Reyna, S, **Grineski, SE**, Collins, TW. 2016. Health status and residential exposure to air toxics: What are the effects on children's academic achievement? *Family & Community Health* 39(3): 160-8. PMID: [27214671](#)
 - b. **Clark-Reyna SE, **Grineski SE**, Collins TW. 2016. Residential exposure to air toxics is linked to lower grade point averages among school children in El Paso, Texas, USA. *Population and Environment* 37(3):319-340. Epub 2016/04/02. PMCID: [PMC4809637](#)
 - c. **Grineski, SE.**, Collins, TW, Adkins, DA. 2020. Exposure to hazardous air pollutants is associated with worse performance in reading, math, and science among US primary schoolchildren. *Environmental Research* doi: [10.1016/j.envres.2019.108925](#).
 - d. Collins, TW, **Nadybal, S, **Grineski, SE**. 2019. Social Disparities in Exposure to Noise at Public Schools in the Contiguous United States. *Environmental Research*. 175, 257-265
- 2. Advancing Environmental Health Justice Methods:** My collaborators and I have also contributed to advances research by pushing forward methodological innovations and new statistical approaches for studying distributional environmental injustices. Prior to 2010, most multi-variate quantitative studies relied on ordinary least squares (OLS) regression, which is poorly suited to spatial data. This is because spatial data often exhibits spatial autocorrelation, which is the tendency of variables to be influenced by their neighbors. This means that the error terms from the regression analysis do not satisfy the independence conditions generally associated with OLS regression. To address this, we led the change in the field toward the use of spatial autoregressive (SAR) models, which can appropriately deal with spatial dependence (b-d). More recently, we have been using individual-level data in studies of environmental justice (a), which has necessitated that we introduce statistical approaches not commonly used in EJ research, specifically statistical techniques appropriate for missing, clustered and non-normally distributed data, in order to support valid inferences.

- a. **Grineski, SE**, Collins, TW, Chakraborty, J, **Montgomery, M. 2017. Hazard characteristics and patterns of environmental injustice: Household-level determinants of environmental risk in Miami, Florida. *Risk Analysis*. 37(7): 1419–1434
- b. **Grineski, SE**, Collins, TW, **McDonald, Y, **Aboargob, F, **Eldeb, A, Romo Aguilar, L, Velázquez-Angulo, G. 2015. Double exposure and the climate gap: Changing demographics and extreme heat in Ciudad Juárez, Mexico. *Local Environment*. 20(2): 180-201. (PMID: 25642135)
- c. **Grineski, SE**, Collins, TW. 2010. Environmental injustice in transnational context: Urbanization and industrial hazards in El Paso/Ciudad Juárez. *Environment and Planning A*. 42(6): 1308-1327.
- d. **Grineski, SE**, Collins, TW, Romo Aguilar, L, Aldouri, R. 2010. No safe place: Environmental hazards & injustice along Mexico's northern border. *Social Forces*. 88(5): 2241-2266.

3. Socioenvironmental Disparities in Asthma: Relying on qualitative/interview methods, my early work focused specifically on children's asthma. I sought to understand parents' experiences as they coped with their child's asthma under very different social and physical environments (a-d). Drawing from three diverse school districts in Phoenix, AZ, my 53 participants ranged from low-income undocumented immigrant parents living in substandard housing in the central city to professional parents with high levels of income and expensive homes living near a regional park. Through the analysis of interview transcripts, I learned that the element of control (over ambient conditions, home environment, health care, and school experiences) was a key factor in parents' abilities to improve the health of their child, and that the poor parents were severely constrained in their ability to control their child's surroundings. The benefits of control seem to be psychosocial (feeling in control) and physical (reducing asthma triggers, managing asthma effectively) (b).

- a. **Grineski, SE**, ***Hernández, AA. 2010. Landlords, fear and children's respiratory health: An untold story of environmental injustice in the central city. *Local Environment*. 15(3): 197–214.
- b. **Grineski, SE**. 2008. Childhood Asthma, Public Housing, and Environmental Control: Differences between families renting with Section 8 vouchers and those living in the "Projects". *Journal of Poverty*. 12(4): 432-455.
- c. **Grineski, SE**. 2009. Parental accounts of children's asthma care: The roles of cultural, social, and economic capitals in health disparities. *Sociological Focus*. 42(2): 107-143.
- d. **Grineski, SE**. 2008. Coping with asthma in the central city: Parental experiences with children's health care. *Journal of Health Care for the Poor and Underserved*. 19(1): 227-236.

A full list of research-related published work can be found at:

<https://scholar.google.com/citations?user=IKSypQYAAAAJ&hl=en&oi=ao>

D. Ongoing Research Support

R25ES031497 (Grineski: Lead PI on MPI team)

Health, Air Pollution, and Population Initiative in Education and Science Training (HAPPIEST).

03/4/2021-02/28/2026

R21ES032137 (Grineski: Co-I)

Environmental Exposures of the Northern Arapaho Tribe: An Exploratory Study.

04/01/2021-03/31/2023

NSF CMMI-2127932 (Grineski: Co-PI)

Collaborative Research: RAPID: Cascading Impacts of the 2021 Texas Winter Storm on Subsidized Housing Residents: A Comparative Analysis.

5/01/2021-04/30/2023

NSF 2055434 (Grineski: PI)

Collaborative Research: Effects of mentorship diversity on student outcomes among NSF Research Experiences for Undergraduates (REU) participants.

07/01/2021 – 06/30/2024

BIOGRAPHICAL SKETCH

NAME: Collins, Timothy William

POSITION TITLE: Professor, Geography and Environmental & Sustainability Studies, University of Utah

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE	Completion Date	FIELD OF STUDY
California State University, Chico	B.A.	05/1998	Geography
California State University, Chico	M.A.	05/2000	Geography
Arizona State University (ASU), Tempe, AZ	Ph.D.	12/2005	Geography

A. Personal Statement

My research focuses on environmental justice in the context of human exposures to hazards, risks, and disasters. I have published numerous such studies focused specifically on air pollution. As an environmental social scientist, I also have extensive experience with designing and administering structured social surveys to collect data from at-risk populations, as well as collaborating on transdisciplinary, team-based research projects investigating issues of environmental justice and environmental health disparities. I am an appointed member of the EPA (Office of Research and Development) Board of Scientific Counselors, Social and Community Science Subcommittee. I have successfully collaborated with Drs. Grineski and Kelly on research projects closely related to the one proposed. Along with Dr. Grineski, I co-lead a National Institutes of Environmental Health Sciences R25 grant (HAPPIEST: Health, Air Pollution, and Population Initiative in Education and Science Training) that will support the proposed project. In sum, I have the technical expertise as well as the collaborative research experience needed to co-lead the structured social survey element of the proposed project.

Publications closely related to the proposed project include:

1. Mullen, C., S. Grineski, **T. Collins**, W. Xing, R. Whitaker, T. Sayahi, ... and K. Kelly. 2020. Patterns of distributive environmental inequity under different PM_{2.5} air pollution scenarios for Salt Lake County public schools. *Environmental Research* 186:109543.
2. Grineski, S., **T. Collins**, and D. Adkins. 2020. Hazardous air pollutants are associated with worse performance in reading, math, and science among US primary schoolchildren. *Environmental Research* 181:108925.
3. **Collins, T.**, and S. Grineski. 2019. Environmental injustice and religion: Outdoor air pollution disparities in metropolitan Salt Lake City, Utah. *Annals of the American Association of Geographers* 109(5):1597-1617.
4. Grineski, S., and **T. Collins**. 2018. Geographic and social disparities in exposure to air neurotoxins at U.S. public schools. *Environmental Research* 161:580-587.

B. Positions and Employment

2022-2025	Member, Board of Scientific Counselors, Social and Community Science Subcommittee, U.S. Environmental Protection Agency, Office of Research and Development, Durham, NC
2019-	Undergraduate Director, Department of Geography; Co-Director (with Sara Grineski), Center for Natural and Technological Hazards; University of Utah, Salt Lake City, UT
2018-	Professor, Department of Geography, University of Utah, Salt Lake City, UT
2015-2017	Professor, Department of Sociology & Anthropology, University of Texas at El Paso (UTEP), El Paso, TX
2014-2017	Director, Institutional Development Core, NIH-funded BUILDing SCHOLARS Center, UTEP, El Paso, TX
2011-2015	Associate Professor, Department of Sociology & Anthropology, UTEP, El Paso, TX
2006-2011	Assistant Professor, Department of Sociology & Anthropology, UTEP, El Paso, TX

2005-2006 Postdoctoral Research Associate, National Science Foundation (NSF) funded Decision Center for a Desert City (DCDC), ASU, Tempe, AZ

C. Contribution to Science

List of published work in Google scholar

<https://scholar.google.com/citations?user=qGHVB1QAAAAJ&hl=en>

1. I began my career as a researcher focused on societal **vulnerability to hazards/risks/disasters**. I have contributed to knowledge by clarifying influences on people's perceptions and decision-making regarding environmental hazards, and by contributing to the environmental justice (1.A, 1.B) literature through quantitative socio-spatial analyses of risks to specific population subgroups (e.g., children and sexual minorities) from multiple types of hazards. I have also developed techniques for quantitatively analyzing distributive environmental justice at the individual level (using data I collected using structured social survey methods similar to those in the proposed project) (1.C, 1.D).
 - a. **Collins, T.**, S. Nadybal, and S. Grineski. 2019. Social disparities in exposure to noise at public schools in the contiguous United States. *Environmental Research* 175:257-265.
 - b. **Collins, T.**, S. Grineski, and D. Morales. 2017. Environmental injustice and sexual minority health disparities: A national study of inequitable health risks from air pollution among same-sex partners. *Social Science & Medicine* 191:38-47.
 - c. **Collins, T.**, S. Grineski, J. Chakraborty, and A. Flores. 2019. Environmental injustice and Hurricane Harvey: A household-level study of socially disparate flood exposures in Greater Houston, Texas, USA. *Environmental Research* 179:108772.
 - d. **Collins, T.**, S. Grineski, J. Chakraborty, M. Montgomery, and M. Hernandez. 2015. Downscaling environmental justice analysis: determinants of household-level hazardous air pollutant exposure in Greater Houston. *Annals of the Association of American Geographers* 105(4):685-703.
2. I have adopted a primary research focus on **environmental health and developmental disparities**. My interest in health disparities extends from my grounding in the hazards and environmental justice research fields. Within those fields, analysts typically assume that disparate health impacts exist based on unequal environmental exposures; however, few analysts in those fields examine actual health or developmental outcomes. In the past five years, I have contributed to knowledge of environmental health disparities through collaborative analyses of air pollution exposures (see 2.A below) and post-flood health effects (2.B). This is in addition to my collaborative research regarding the impact of environmental exposures on children's intellectual performance (see 2.C, 2.D).
 - a. Grineski, S., **T. Collins**, J. Chakraborty, and Y. McDonald. 2013. Environmental health injustice: Exposure to air toxics and children's respiratory hospital admissions. *The Professional Geographer* 65(1):31-46.
 - b. **Collins, T.**, A. Jimenez, and S. Grineski. 2013. Hispanic health disparities after a flood disaster: Results of a population-based survey of individuals experiencing home site damage in El Paso (Texas, USA). *Journal of Immigrant and Minority Health* 15(2):415-426.
 - c. Grineski, S., S. Clark-Reyna, and **T. Collins**. 2016. School-based exposure to hazardous air pollutants and grade point average: a cross-sectional study. *Environmental Research* 147:164-171.
 - d. Clark-Reyna, S., S. Grineski, and **T. Collins**. 2016. Residential exposure to air toxics is linked to lower grade point averages among school children in El Paso, Texas, USA. *Population & Environment* 37(3):319-340.
3. I have contributed to knowledge regarding **human dimensions of climate change**. Through collaborative research, I have clarified important socio-behavioral dimensions of climate change-related hazards, such as wildfire (3.A), extreme heat (3.B), and flooding (3.C, 2.B). Additionally, I have elaborated novel methods to characterize cumulative risks to climate change-related hazards at a fine spatial scale (3.D).

- a. **Collins, T.** 2008. What influences hazard mitigation? Household decision making about wildfire risks in Arizona's White Mountains. *The Professional Geographer* 60(4):508-526.
 - b. Renteria, R., S. Grineski, **T. Collins**, A. Flores, and S. Trego. 2022. Social disparities in neighborhood heat in the Northeast United States. *Environmental Research* 203:111805.
 - c. Chakraborty, J., **T. Collins**, and S. Grineski. 2019. Exploring the environmental justice implications of Hurricane Harvey flooding in Greater Houston, Texas. *American Journal of Public Health* 109(2):244-250.
 - d. **Collins, T.**, S. Grineski, P. Ford, R. Aldouri, L. Romo, G. Velázquez-Angulo, R. Fitzgerald, and D. Lu. 2013. Mapping vulnerability to climate change-related hazards: children at-risk in a U.S.-Mexico border metropolis. *Population & Environment* 34(3):313-337.
4. I have innovated through **nuanced examination of racial/ethnic dimensions of environmental justice and environmental health disparities**. In distributive environmental justice research, quantitative studies have almost entirely relied on broad racial and ethnic categorizations (e.g., Hispanic or Asian). Analysts have thus implicitly assumed a large degree of homogeneity within racial/ethnic minority populations, which may be unfounded, and they have failed to clarify how racial/ethnic status articulates with other social characteristics in contributing to disparate environmental risks and health outcomes. My collaborative research has helped to demonstrate that the Hispanic/Latino and Asian categories mask substantial heterogeneity that is of direct relevance to intra-ethnic environmental injustices and health disparities. These studies have revealed that salient axes of difference within the Hispanic and Asian populations—such as English-language proficiency, nativity (US-born vs. foreign-born), country of origin, and socioeconomic status—may significantly predict variation in environmental risks (4.A, 4.B) and children's health and developmental outcomes (4.C, 4.D).
- a. **Collins, T.**, S. Grineski, J. Chakraborty, and Y. McDonald. 2011. Understanding environmental health inequalities through comparative intracategorical analysis: racial/ethnic disparities in cancer risks from air toxics in El Paso County, Texas. *Health & Place* 17(1):335-344.
 - b. Grineski, S., **T. Collins**, and D. Morales. 2017. Asian Americans and disproportionate exposure to carcinogenic hazardous air pollutants: a national study. *Social Science & Medicine* 185:71-80.
 - c. Kim, Y., **T. Collins**, and S. Grineski. 2014. Neighborhood context and the Hispanic health paradox: Differential effects of immigrant density on children's wheezing by poverty, nativity and medical history. *Health & Place* 27:1-8.
 - d. Rubio, R., S. Grineski, D. Morales, and **T. Collins**. 2019. The role of parents' nativity in shaping differential risks of food insecurity among US first graders. *Maternal and Child Health Journal* 23(7):910-918.

D. Ongoing Research Support

NIH (NIEHS) R25ES031497 (Collins: Multiple PI)

Health, Air Pollution, and Population Initiative in Education and Science Training (HAPPIEST).

3/4/2021 – 2/28/2026

NSF 2127932 (Collins: PI)

Collaborative Research: RAPID: Cascading Impacts of the 2021 Texas Winter Storm on Subsidized Housing Residents: A Comparative Analysis.

5/1/2021 – 4/30/2023

NSF 2055434 (Collins: Co-PI)

Collaborative Research: Effects of mentorship diversity on student outcomes among NSF Research Experiences for Undergraduates (REU) participants.

7/1/2021 – 6/30/2024

Manifest for Grant Application # GRANT13579625

Grant Application XML file (total 1):

1. GrantApplication.xml. (size 27079 bytes)

Forms Included in Zip File(total 6):

1. Form ProjectNarrativeAttachments_1_2-V1.2.pdf (size 16012 bytes)
2. Form SF424_3_0-V3.0.pdf (size 24147 bytes)
3. Form SF424A-V1.0.pdf (size 22747 bytes)
4. Form EPA4700_4_3_0-V3.0.pdf (size 22750 bytes)
5. Form OtherNarrativeAttachments_1_2-V1.2.pdf (size 15919 bytes)
6. Form EPA_KeyContacts_2_0-V2.0.pdf (size 37245 bytes)

Attachments Included in Zip File (total 10):

1. OtherNarrativeAttachments_1_2 OtherNarrativeAttachments_1_2-Attachments-1239-Biosketches.pdf application/pdf (size 264421 bytes)
2. OtherNarrativeAttachments_1_2 OtherNarrativeAttachments_1_2-Attachments-1237-Tellus_Budget.pdf application/pdf (size 927358 bytes)
3. OtherNarrativeAttachments_1_2 OtherNarrativeAttachments_1_2-Attachments-1242-UU_Budget.pdf application/pdf (size 115133 bytes)
4. OtherNarrativeAttachments_1_2 OtherNarrativeAttachments_1_2-Attachments-1236-UCC_Budget.pdf application/pdf (size 26383 bytes)
5. OtherNarrativeAttachments_1_2 OtherNarrativeAttachments_1_2-Attachments-1241-QualityAssuranceStatement.pdf application/pdf (size 228377 bytes)
6. OtherNarrativeAttachments_1_2 OtherNarrativeAttachments_1_2-Attachments-1238-UDAQ_Budget.pdf application/pdf (size 73115 bytes)
7. OtherNarrativeAttachments_1_2 OtherNarrativeAttachments_1_2-Attachments-1240-LettersOfSupport.pdf application/pdf (size 4747092 bytes)
8. ProjectNarrativeAttachments_1_2 ProjectNarrativeAttachments_1_2-Attachments-1243-ProjectNarrative.pdf application/pdf (size 5577695 bytes)
9. OtherNarrativeAttachments_1_2 OtherNarrativeAttachments_1_2-Attachments-1235-FRIENDS_Budget.pdf application/pdf (size 33042 bytes)
10. OtherNarrativeAttachments_1_2 OtherNarrativeAttachments_1_2-Attachments-1234-Final Memo Approval from Bryce WS00850874.pdf application/pdf (size 103729 bytes)

Letters of Support

Partner	Role Summary	Page
Utah Clean Cities	Inland port, community, EPA Port Collaborative Toolkit	2
Friends of the Great Salt Lake	Great Salt Lake ecosystem and outreach	4
University of Utah	Low-cost sensors, survey, and outreach	7
Tellus Networked Sensor Solutions	Sensors, backend, automated QA, and visualizations	10
US Ignite	Documentation of Tellus sensor performance on federally funded projects	11
State Health Department	Community health and policy	13
Salt Lake County Health Department	Community and policy	15
Inland Port Authority	Policy implementation for Inland Port	16
Community Councils	Community needs and engagement	17
City of Magna	Community and policy	20
Salt Lake City Sustainability	Community and policy	21
UCAIR	Air quality public-private partnership	22
Breathe Utah	Air quality grassroots organization	24
Utah Clean Energy	Energy equity	25
DUSTKids	Education and outreach	26
UU Bennion Center and HAPPIEST	Education, outreach, and environmental justice.	27
UDEQ EJ Committee	Community engagement	29
Purple Air - sensors	Air quality data	30

March 10, 2022

TO:

Dr. Nancy Daher
Research Scientist, Utah

Division of Air Quality
195 N 1950 W
Salt Lake City, UT 84116

Dear Dr. Daher

Utah Clean Cities (UCC) is delighted to partner with you on your proposal to the US EPA entitled “Addressing Air Pollution Inequities in the Salt Lake Valley through Community-Engaged Particle Monitoring”. The Utah Clean Cities team brings over 30 years of experience with advanced fuel technologies coupled with emission reductions tools and community resources to address possible negative impacts of the UIPA. Utah Clean Cities is an award-winning, state-wide coalition within the US DOE’s vehicle technologies program - designed to promote local leadership with alternative fuels and fuel economy strategies.

Our state, and in particular, the Salt Lake Valley struggles to meet national ambient air quality standards and struggles with serious non-attainment status. The Utah Inland Port Authority, UIPA, being developed in the northwest quadrant of the Salt Lake Valley, will bring major impacts to the Salt Lake Valley, particularly the communities surrounding the Port. The Port will bring increased traffic and corresponding air emissions to this area of the Valley that is already economically disadvantaged and experiences disproportionately poor air quality. For example, the communities surrounding the Port predominantly have an environmental justice index in the 80th percentile or greater for PM_{2.5} (compared to the state).

Continued on following page

Continued from page 1

We are currently working to understand and address the environmental impacts of the UIPA and your proposed project and our efforts are highly complementary. We recently received a US EPA environmental justice grant (Supporting Near-Port Communities in Addressing Harmful Air Quality Impacts) to support our near-port communities through direct engagement. Specifically, we will be performing a collective needs assessment, developing community educational resources, hosting listening sessions with community members and leaders, developing a community committee, and utilizing EPA's Community Port Collaborative Toolkit.

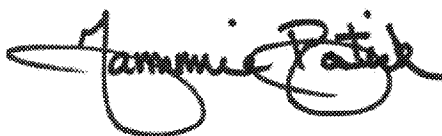
We are enthusiastic about leveraging our strengths in community engagement, our work with the Port Collaborative toolkit, and our US EPA grant to enhance the success of your project. Air quality measurements in and around the Inland Port are very limited, and your project will lead to an improved understanding of how the Port will affect air quality. Ultimately, your work will inform our Port action plan. We greatly value the Division of Air Quality's technical expertise and interest in true community partnerships, and we also appreciate our long-standing work with Dr. Kelly, the prime collaborator on this project.

If funded, we anticipate partnering with your team in the following ways:

- Welcoming your participation in our collective needs assessment and in our community listening sessions;
- Co-developing educational materials;
- Working through the EPA community port collaborative toolkit as we prioritize goals. Your participation is particularly welcome because you are an agency with decision-making influence and because of your expertise as we develop our action plan;
- Assisting you in siting monitors in areas of greatest concern to the communities;
- Offering the project team the opportunity to engage with community members who would be interested in your surveying and outreach efforts;
- Serving on the project steering committee.

We are looking forward to working with you on this important project.

Regards,



Tammie Bostick, Executive Director

801-580-1922



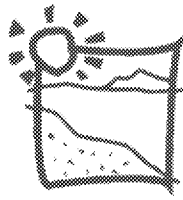
tammie.bostick@utahcleancities.org



451 South State, Suite 415



Salt Lake City, Utah 84111³



FRIENDS of GREAT SALT LAKE

150 South 600 East, Suite 5D • Salt Lake City, UT 84102 • (801) 583-5593 • www.fogsl.org

Dr. Nancy Daher
Research Scientist, Utah Division of Air Quality
195 N 1950 W, Salt Lake City, UT 84116

Tuesday March 8, 2022

Dear Dr. Daher,

I am writing to commit the support of FRIENDS of Great Salt Lake (FRIENDS) to the project “Addressing Air Pollution Inequities in the Salt Lake Valley through Community-Engaged Particle Monitoring” proposed by the Utah Division of Air Quality (UDAQ), should it be funded by the Enhanced Air Quality Monitoring for Communities grant (RFA#: EPA-OAR-OAQPS-22-01).

FRIENDS is a nonprofit organization founded in 1994 with the mission to preserve and protect the Great Salt Lake ecosystem and to increase public awareness and appreciation for the lake through education, research, advocacy, and the arts. Agricultural, municipal, and industrial water demands within our watershed have drained the lake to a new historic low. Now, two thousand square kilometers of dry lakebed sediments are exposed to potential erosion and entrainment in the atmosphere. There has never been a more critical time to understand how communities near Great Salt Lake, especially underserved communities, are being affected by particulate pollution. Yet, there are very few PM2.5 and PM10 monitoring stations around the lake – and you can’t manage what you can’t measure.

FRIENDS is committed to supporting conservation actions that keep water in Great Salt Lake and our air healthy. As part of this grant request, FRIENDS is pleased to partner with UDAQ to design a community engagement campaign that can inform and enhance UDAQ’s proposed expansion of air quality monitoring networks. As detailed in Section 2.A. of this proposal, our multi-phase campaign will:

- 1) Collect input from community members to assess awareness and identify concerns and priorities
- 2) Recruit community leaders to join your steering committee and evaluate how community input should inform sensor deployment sites and engagement opportunities
- 3) Include a FRIENDS representative on your community steering committee
- 4) Engage community members through education and volunteer events that empower residents to be involved in monitoring their own air quality

FRIENDS will leverage existing relationships with our community partners for this work, including but not limited to community councils, school districts, and Antelope Island State Park (see attached support letter).

The desiccation of Great Salt Lake raises significant air quality concerns and an urgent need for increased monitoring, transparency, and community engagement. This project will create opportunities for community members to voice their concerns and participate in the collection of measurements that could help inform decisions surrounding the preservation of the lake and mitigation of negative health outcomes. I highly support the proposed work and can assure you that our community would greatly benefit from the project findings.

Sincerely,

Executive Director

Dr. Nancy Daher
Research Scientist, Utah Division of Air Quality
195 N 1950 W
Salt Lake City, UT 84116

Dear Dr. Daher,

We are writing to express our enthusiastic support of the project "Addressing Air Pollution Inequities in the Salt Lake Valley through Community-Engaged Particle Monitoring" proposed by the Utah Division of Air Quality (UDAQ).

Increased human water use and severe drought have drained Great Salt Lake to a new historic low. Now, two thousand square kilometers of dry lakebed sediments are exposed to potential erosion and entrainment in the atmosphere – adjacent to our population of over two million people. There is no time to waste in evaluating how communities near Great Salt Lake, especially underserved communities, are being affected by particulate pollution. Yet, as it stands, there are very few air quality monitoring stations in the Salt Lake Valley.

We support your proposal to expand the number of PM_{2.5} and PM₁₀ sensors deployed around Great Salt Lake and near our homes, which will help mitigate negative health outcomes associated with fugitive dust and inform decisions surrounding the preservation of the lake.

We have an existing working relationship with FRIENDS and, should your project receive funding, are willing to support them and UDAQ in one or more of the following ways:

- Providing access to place sensors (following appropriate permitting protocols)
- Inviting project investigators to present to our organization, board, or at a community meeting
- Helping to gauge community concerns about air pollution by distributing surveys to our members and encouraging participation in focus group sessions
- Giving feedback on sensor locations and how to best disseminate information to the public in a clear and easily digestible way

- Working together with FRIENDS to host a K-12 outreach event that incorporates educational modules developed by the project team (e.g., building Lego air quality sensors)

We believe that UDAQ and your partners at the University of Utah, Utah Clean Cities, and FRIENDS of Great Salt Lake have the necessary expertise to carry out this project and trust that you are committed to amplifying the voices of those most affected by particulate pollution. If funded, the proposed project will benefit both the health of our community and our beloved Great Salt Lake ecosystem.

Sincerely,

List of Signatures:

#	Name	Organization
1	Molly Blakowski	FRIENDS of Great Salt Lake
2	Alex Porpora, Executive Director	Utah Society for Environmental Education
3	Kylie Jones-Greenwood	Tracy Aviary
4	Wendy Wilson	Antelope Island State Park
5	Deanna Taylor	Blue Sky Institute



Dr. Nancy Daher
Research Scientist, Utah Division of Air Quality
195 N 1950 W
Salt Lake City, UT 84116

March 21, 2022

Dear Dr. Daher,

We are writing to enthusiastically confirm our intent to collaborate with your team on your proposal to the US EPA entitled “Addressing Air Pollution Inequities in the Salt Lake Valley through Community-Engaged Particle Monitoring.” We are committed to understand and address air quality in the Salt Lake Valley, where we live and work, and we are delighted to continue working with underserved communities in our region. Dr. Kelly is delighted to build on our previous successful collaborations that led to a better understanding of several air toxics (formaldehyde and dichloromethane) and of ammonia sources. We (Dr. Kelly, Grineski and Collins) also have a track record of collaborating and publishing on the use of low-cost sensors to better understand environmental inequities in schools in the Salt Lake Valley.

Dr. Kelly brings expertise in low-cost sensing networks. She led a team who developed a low-cost sensing infrastructure in the Salt Lake Valley that integrates measurements from her AirU sensors, PurpleAir sensors, and UDAQ stations with rigorous calibration and quality assurance using a Gaussian Process model to generate accurate, near-real-time, easy-to-understand estimates of PM_{2.5} concentration throughout much of the Salt Lake Valley. Her laboratory developed the capabilities to calibrate low-cost particulate matter and gas sensors, and her students maintain seasonal and event-specific correction factors for AirU and PurpleAir sensors through our collaborations with UDAQ. Dr. Kelly and her students will be responsible for the following tasks:

- Calibrating the PM_{2.5} and PM₁₀ air-quality sensors in the laboratory and field.
- Developing calibration factors that will be deployed in in the sensor network.
- Deploying approximately 50 sensors in the Salt Lake Valley. This will include sensor siting, installation, and trouble shooting.
- Participating in the project’s community engagement activities. This includes developing activities for the project that can be used in schools and community events.
- Analyzing the air quality data and performing quality assurance tasks
- Managing the project’s website
- Deploying and managing the instant, location-specific, air quality alert messaging.

Drs. Collins and Grineski bring expertise in surveying populations and conducting geographic information system analyses to understand and address environmental justice issues. They have developed and administered social surveys for research projects funded by the US National Institutes of Health, EPA, and National Science Foundation. Their research team has conducted several studies focused on environmental justice and environmental health issues pertaining to air pollution in the Salt Lake Valley. They have

recently published a study of environmental justice issues for schoolchildren in the Salt Lake Valley based on PM_{2.5} estimates from a network of low-cost sensors (with Dr. Kelly), as well as articles highlighting the socially inequitable distribution of PurpleAir sensors more generally. They will be responsible for:

- Developing and conducting an IRB-approved probability-based, structured social survey of Westside residents focused on their perceptions, attitudes and behaviors pertaining to air quality, the Great Salt Lake, and the inland port. This will include managing the students performing the survey and recruiting participants with a multi-modal approach.
- Translating the survey into Spanish.

We are looking forward to continue to work together.

Sincerely,



Kerry E. Kelly, PE, PhD
Associate Professor,
Chemical Engineering



Timothy Collins, PhD
Professor, Geography

Sara Grineski, PhD
Professor, Sociology

Dr. Nancy Daher
Research Scientist, Utah Division of Air Quality
195 N 1950 W
Salt Lake City, UT 84116

March 12, 2022

Dear Dr. Daher,

I am an Associate Professor (Lecturing) in Chemical Engineering at the University of Utah, and I direct our highly successful outreach program. Annually we visit approximately 50-100 classrooms and numerous community outreach events. Our outreach program aims to engage K-12 students in STEM concepts, and your collaborator, Dr. Kelly, and I have developed numerous teaching modules related to air quality and low-cost air sensing. Our most popular module is a hands-on activity focused on building air quality sensors from Legos™, and this module has received national press coverage and was demonstrated at the National Science and Engineering Expo in Washington, DC.

My outreach team and I are delighted to work with you on your proposed project "Addressing Air Pollution Inequities in the Salt Lake Valley through Community-Engaged Particle Monitoring". I am especially enthusiastic about projects, like this one, that illustrate how engineering is a "helping" profession. If funded, my team and I will work with you to develop fun and engaging outreach activities for your community events, and our student outreach ambassadors will attend community events with our activities.

I also appreciate your commitment to support our outreach efforts through financial support, and I look forward to working with you on this important project.

Sincerely,

Anthony E. Butterfield

Anthony E. Butterfield, PhD
Associate Professor Lecturing, Chemical Engineering
University of Utah
tony@chemeng.utah.edu
801-699-1969

Department of Chemical Engineering
50 S Central Campus Dr., 3290 MEB
Salt Lake City, Utah 84112
(801) 581-6915

March 23, 2022
Dr. Nancy Daher
Research Scientist, Utah Division of Air Quality
195 N 1950 W
Salt Lake City, UT 84116

Dear Dr. Daher,

The University of Utah would like to confirm that if your proposal to the US EPA entitled “Addressing Air Pollution Inequities in the Salt Lake Valley through Community-Engaged Particle Monitoring” is funded, we intend to collaborate with the Utah Division of Air Quality on the following scope of work:

- Calibrating air-quality sensors in the laboratory and field.
- Developing calibration factors that will be deployed in in the sensor network.
- Deploying approximately 50 sensors in the Salt Lake Valley. This will include sensor siting, installation, and trouble shooting.
- Participating in the project’s community engagement activities. This includes developing activities for the project that can be used in schools and community events.
- Developing and conducting an IRB-approved probability-based, structured social survey of Westside residents focused on their perceptions, attitudes and behaviors pertaining to air quality, the Great Salt Lake, and the inland port.
- Analyzing the air quality data and performing quality assurance tasks.
- Translating the survey into Spanish
- Managing the project’s website
- Deploying the instant, location-specific, air quality alert messaging.

We are looking forward to continuing to work together.

Sincerely,



Jennifer Hoskins
Sponsored Projects Officer



Dr. Nancy Daher
Research Scientist, Utah Division of Air Quality
195 N 1950 W
Salt Lake City, UT 84116

March 21, 2022

Dear Dr. Daher,

Tellus Networked Sensor Solutions, Inc. is enthusiastic about collaborating on your proposal to the US EPA entitled "Addressing Air Pollution Inequities in the Salt Lake Valley through Community-Engaged Particle Monitoring". Tellus develops integrated sensor networking solutions. We are a Salt Lake City company, which spun out of the University of Utah, and we developed our network infrastructure for Salt Lake City. We have expanded into communities in Cleveland, OH; Chattanooga, TN; Kansas City, MO; and Springfield, MA (see letter from Glenn Ricart US Ignite). We support communities seeking to understand and address their air quality by providing sensors, a back-end platform, easy and transparent data access (through a data studio for sensor managers and through an API), continually improving front-end experience (website, visualizations, and overlays of key data).

We will collaborate with your team on the following tasks:

- Add the Alphasense OPC-N3 sensor to the AirU platform (AirU+). This including the data feed from the OPC-N3 into our cloud database, integrating the calibration factors developed by the University of Utah for the OPC-N3 to calculate accurate PM_{10} concentrations, implementing conversion factors for the AirU and Purple Air $PM_{2.5}$ concentrations to estimate PM_{10} throughout the study area,
- Developing new maps for PM_{10} in the study area and allowing users to toggle between $PM_{2.5}$ and PM_{10} . Adding overlaps to the maps for wind direction and wildfires.
- Providing back-end support for the sensor network including API access, data studio access, and automated quality assurance (excluding indoor sensors, flagging outliers, flagging drifted sensors, flagging dual sensors that do not agree with each other). The quality assurance plan contains details of this automated data screening methods.
- Providing individual data access for sensor hosts
- Developing the instant, location-specific air quality alerts.

We are looking forward to continue to work together.

Sincerely,

A handwritten signature in black ink, appearing to read "Carl Luft".

Carl Luft
Vice President
Tellus Networked Sensor Solutions, Inc.

Dr. Nancy Daher
Research Scientist, Utah Division of Air Quality
195 N 1950 W
Salt Lake City, UT 84116

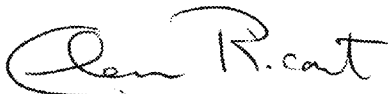
March 17, 2022

Dear Dr. Daher,

US Ignite is excited that the Utah Division of Air Quality is partnering with Tellus Networked Sensor Solutions, Inc. on your proposal entitled "Addressing Air Pollution Inequities in the Salt Lake Valley through Community-Engaged Particle Monitoring." US Ignite is a decade-old nonprofit 501(c)(3) organization with grants from a number of federal agencies such as the National Science Foundation and private philanthropic foundations. We partner with smart communities and research testbeds to drive high-impact solutions to their toughest challenges. Through the public-private partnership programs we run, US Ignite is a catalyst for innovation in smart city services powered by a new generation of technologies.

In 2021, US Ignite contracted with Tellus to develop networks of air quality sensors in Cleveland, OH; Chattanooga, TN; and Kansas City, MO in addition to an initial deployment in the greater Salt Lake City area that was the result of an innovation competition by Utah Ignite. Tellus successfully completed their agreement with our organization and with the communities. The Tellus team delivered their sensors, their data screening/calibration, and their dynamic visualizations on time and with concern for community needs. They also have met all reporting and community support requirements. We're very pleased with the results. We hope you'll also join our monthly Friday calls and share the results of your proposed partnership with Tellus with our national network of communities concerned with air quality.

Sincerely,

A handwritten signature in black ink that reads "Glenn Ricart". The signature is fluid and cursive, with the first name "Glenn" and last name "Ricart" clearly distinguishable.

Glenn Ricart, Ph.D.
Founder and Chief Technical Officer, US Ignite
Glenn.Ricart@us-ignite.org



State of Utah

SPENCER J. COX
Governor

DEIDRE M. HENDERSON
Lieutenant Governor

**Utah Department of Health
Executive Director's Office**

Nate Checketts
Interim Executive Director

Heather R. Borski, M.P.H., M.C.H.E.S.
Deputy Director

Michelle G. Hoffmann M.D., M.P.H., M.H.C.D.S., F.A.A.P.
Deputy Director

Leisha Nolen, M.D., PhD.
State Epidemiologist

Dr. Nancy Daher
Research Scientist, Utah Division of Air Quality
195 N 1950 W
Salt Lake City, UT 84116

3/21/2022

Dear Dr. Daher,

The Utah Department of Health (UDOH) is pleased to support your proposal to the US EPA entitled "Addressing Air Pollution Inequities in the Salt Lake Valley through Community-Engaged Particle Monitoring".

Air quality along Utah's Wasatch Front, where the majority of the population lives, is a critical public health issue. The Salt Lake Valley along the northern Wasatch front faces severe air quality challenges, with PM_{2.5} often exceeding the 24-hr National Ambient Air Quality Standard. Underserved communities in the valley are disproportionately affected by increasing emissions from heavy-duty vehicle traffic and dust from the Great Salt Lake (GSL) due to the vicinity of these communities to the main transport arteries, the desiccating GSL, and the development of Utah's new Inland Port. Data shows that residents with asthma are particularly at risk, a common medical issue for the underserved communities in the areas most affected by poor air quality.

We recognize the value and critical need of improved monitoring and community engagement in underserved neighborhoods of the Salt Lake Valley that is put forward in this application. The proposed work, if funded, will help increase the state's capacity to assess health hazards from PM_{2.5}, inform effective policies and messaging, and empower underserved communities in the Salt Lake Valley to be active participants in addressing environmental health disparities in their communities.

If funded, we anticipate supporting your project in the following ways:

- Sharing air quality complaints submitted to UDOH by concerned citizens and communities
- Inviting you to participate in our Air Quality workgroup, which can provide expert feedback and insight regarding your project design and findings
- Providing feedback on your air pollution maps and how best to communicate findings to the public
- Develop public health recommendations to prevent or reduce exposure to air pollutants
- Publicizing your real-time air quality maps and disseminating results through our existing programs and task forces. These include our Asthma Task Force, the Utah Environmental Epidemiology Program website, and the Utah Air Quality workgroup



State of Utah

SPENCER J. COX
Governor

DEIDRE M. HENDERSON
Lieutenant Governor

Utah Department of Health
Executive Director's Office

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Interim Executive Director

Heather R. Borski, M.P.H., M.C.H.E.S.
Deputy Director

Michelle G. Hoffmann M.D., M.P.H., M.H.C.D.S., F.A.A.P.
Deputy Director

Leisha Nolen, M.D., PhD.
State Epidemiologist

- Having UDOH representation on your community steering committee as requested
- Support in community outreach and engagement to increase community members' understanding of air pollutant exposures and how to protect themselves by adopting public health recommendations.
- Partner on the development of an "Instant Location-Specific Air Quality Alert System" that will notify registered users when their local air quality is poor. This includes crafting the messaging, suggesting actions to take, and publicizing the tool on our website and network of partners.

We are looking forward to working with you on this project.

Sincerely,

Alejandra Maldonado, PhD
State Toxicologist
Bureau of Epidemiology

Anna Fondario, MPH
Bureau Director of Health Promotion and Prevention

Leisha Nolen, MD, PhD
State Epidemiologist

Dr. Nancy Daher
Research Scientist, Utah Division of Air Quality
195 N 1950 W
Salt Lake City, UT 84116

March 7, 2022

Dear Dr. Daher,

The Salt Lake County Health Department (SLCHD) is delighted to support your proposal to the US EPA entitled "Addressing Air Pollution Inequities in the Salt Lake Valley through Community-Engaged Particle Monitoring". I manage SLCHD's air quality bureau and lead several programs to improve air quality in the Salt Lake Valley including educational activities, oversight of vehicle emissions testing, and regulation of solid-fuel burning. Salt Lake faces several air-quality challenges including non-attainment status for PM_{2.5} and ozone, a rapidly growing population, the decline of the Great Salt Lake, and the development of Utah's new inland port d. Salt Lake County's underserved areas are disproportionately affected by heavy-duty vehicle traffic and dust from the Great Salt Lake, and these burdens are likely to increase due to population growth and Utah's new Inland Port. We appreciate the value of improved monitoring in these communities to help inform effective policies.

We anticipate supporting your project in the following ways:

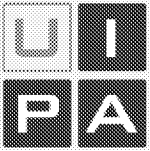
- Guiding the placement of sensors.
- Providing feedback on your pollution maps and how you are communicating measurements to the public.
- Publicizing your real-time, air quality maps and results through our network of partners.
- Assisting with community engagement efforts.
- Having a SLCHD representative on your community steering committee if desired.
- Sharing our research-grade measurements of PM_{2.5} concentration (MetOne ES-642 equipped with a PM_{2.5} inlet) at locations that we manage, in particular the measurements located at the State Fair Park, which lies within your study area.

We are looking forward to working with you on this project.

Sincerely,

Corbin Anderson

Corbin Anderson, BS, MA, LEHS
Bureau Manager
Air Quality Bureau
Salt Lake County Health Department



UTAH INLAND PORT AUTHORITY

Dr. Nancy Daher
Research Scientist, Utah Division of Air Quality
195 N 1950 W
Salt Lake City, UT 84116

March 18, 2022

Dear Dr. Daher,

The Utah Inland Port Authority (UIPA) is writing to support your proposal to the US EPA entitled "Addressing Air Pollution Inequities in the Salt Lake Valley through Community-Engaged Particle Monitoring". The UIPA is a state corporation directed to maximize the long-term benefits of a robust logistics system while maintaining a high quality of life. Our mission is to promote sustainable, equitable and smart logistics through programs, policies, and partnerships. Air quality is recognized as one of the biggest quality of life concerns in Utah, and UIPA is committed to do our part in mitigating PM_{2.5} emissions over predicted baseline within the port jurisdictional area and the surrounding community. Your measurements will support us in understanding baseline and working toward a shared vision. In addition, we are committed to translating science into sound policy, and we are delighted to partner with your team to better understand and address our region's air quality challenges.

We also appreciate the Utah Division of Air Quality and your collaborator, Dr. Kelly's, willingness to share their knowledge with our Community Advisory Council, and we look forward to building on these relationships. When your project is funded, we intend to partner with your team the following ways:

- Supporting communication for low-cost sensor measurements through our Intelligent Crossroads Network (ICN). The ICN is a private 5G/LTE network built to support the entire jurisdictional area and the first network designed for the supply chain with ancillary benefits like supporting programs like yours.
- Assisting with identifying locations for your sensors and identifying sensor hosts within the port.
- Serving as a mechanism to translate your findings into policy as we build out the Port and transportation corridors while considering needs of the community.

We are looking forward to working with your team.

Sincerely,

Jill Flygare
Chief Operating Officer, Utah Inland Port Authority

Board of Directors

Turner C Bitton
Chair

Paulo Aguilera
Vice Chair

Jenny Erickson
Webmaster

Cody Egan
Treasurer

Taylor Thurman
Secretary

Stephanie Finley
At-Large Member

Scott Hortin
At-Large Member

Emilie Jordao
At-Large Member

Stephen Kopaunik
At-Large Member

Jaycee Miller
At-Large Member

Levi de Oliveira
At-Large Member

Sarah Wolfe
At-Large Member

March 2, 2022

Dr. Nancy Daher
Research Scientist, Utah Division of Air Quality
195 North 1950 West
Salt Lake City, UT 84116

Dear Dr. Daher,

I am writing to express the Glendale Community support for your proposal to the US EPA entitled "Addressing Air Pollution Inequities in the Salt Lake Valley through Community-Engaged Particle Monitoring". Our community is disproportionately affected by heavy duty vehicle traffic and is downwind of an area of the Great Salt's dry lakebed. Air quality is a growing concern for us, particularly as we look toward the development of the Inland Port, which will increase vehicle traffic near our community, and the decline in the water levels in the Great Salt Lake. With an environmental justice index of 97th percentile for PM_{2.5} (compared to the state), our neighborhood communities are more vulnerable to PM_{2.5} pollution than 97% of Utah's entire population.

We are enthusiastic about bringing neighborhood-scale air quality measurements to our community and believe that these will help us provide much-needed data to drive science-based policy decisions.

We expect to support your project in the following ways:

- Guiding your placement of sensors.
- Inviting your team to continue to present at our community council meetings to help identify sensor hosts and to discuss results and the best way to present results.
- Assisting with your community engagement efforts by promoting opportunities to attend listening sessions, participate in surveys and focus groups, and to feedback on your results.
- Providing links so that our community can view your real-time particle pollution maps.
- Helping identify a community member who would be interested in serving on your community steering committee.

We are looking forward to working with your team.

Sincerely,
Turner Bitton, Chair
Glendale Neighborhood Council





Dr. Nancy Daher
Research Scientist, Utah Division of Air Quality
195 N 1950 W
Salt Lake City, UT 84116

March 15, 202

Dear Dr. Daher,

The Poplar Grove Community Council would like to express its support for your proposal to the US EPA entitled "Addressing Air Pollution Inequities in the Salt Lake Valley through Community-Engaged Particle Monitoring". Our community members are concerned about poor air quality and the associated health effects, and we recognize two important community-level air quality challenges: the development of the Inland Port, which will increase heavy duty vehicle traffic in our community, and the shrinking Great Salt Lake. With an environmental justice index of 98th percentile for $PM_{2.5}$ (compared to state), our neighborhood communities are more vulnerable to $PM_{2.5}$ pollution than 98% of Utah's entire population. We expect that additional air quality measurements in our area will support our citizens as we seek to influence decisions that affect our air quality and health. We appreciate you visiting our council meeting and showing us high-resolution air quality maps.

We are looking forward to supporting your project in the following ways:

- Guiding your placement of sensors.
- Inviting your team to continue to present at our community council meetings to help identify sensor hosts and to discuss results.
- Assisting with your community engagement efforts by promoting opportunities to attend listening sessions, participate in surveys and focus groups, and providing feedback on your results.
- Providing links so that our community can view your real-time particle pollution maps.
- Helping identify a community member who would be interested in serving on your community steering committee.

We are looking forward to working with your team.

Sincerely,

DocuSigned by:

Esther S. Jackson-Stowell

BDC06C9F19DF4BC...

Esther S. Jackson-Stowell, Chair

Poplar Grove Community Council, D2



776 N. East Capital Blvd
Salt Lake City, UT 84103
(801) 910-0920

Dr. Nancy Daher
Research Scientist, Utah Division of Air Quality
195 N 1950 W
Salt Lake City, UT 84116

March 14, 2022

Dear Dr. Daher,

I am writing to express the Capitol Hill Neighborhood Council's support for your proposal to the US EPA entitled "Addressing Air Pollution Inequities in the Salt Lake Valley through Community-Engaged Particle Monitoring". Our community members are very concerned about the increasing heavy duty vehicle traffic and gravel operations along Beck Street that negatively affect our air quality. With an environmental justice index of 82nd percentile for PM_{2.5} (compared to state), our neighborhood communities are more vulnerable to PM_{2.5} pollution than 82% of Utah's entire population.

We are enthusiastic about improved air quality monitoring in our area, and we are happy to support your project in the following ways:

- Provide guidance on the placement of sensors.
- Welcome your team to present at our community council meetings to help identify sensor hosts and to discuss results.
- Assist with your community engagement efforts by distributing to our community opportunities to attend listening sessions, participate in surveys and focus groups, providing feedback on your results, and to view your real-time particle pollution maps.
- Help identify a community member who would be interested in serving on your community steering committee.

We are looking forward to working with your team.

Sincerely,

John Mitchell, Vice Chair
Capitol Hill Neighborhood Council

March 16, 2022

Dr. Nancy Daher
Research Scientist, Utah Division of Air Quality
195 N 1950 W
Salt Lake City, UT 84116

Dear Dr. Daher,

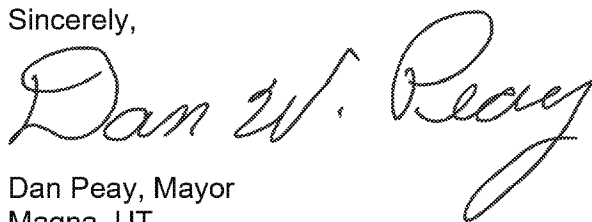
The City of Magna is writing to support your proposal to the US EPA entitled "Addressing Air Pollution Inequities in the Salt Lake Valley through Community-Engaged Particle Monitoring". Magna is located just south/southwest of the Inland Port and Great Salt Lake. Emissions associated with the Inland Port and wind-blown dust from the shrinking Great Salt Lake are a concern for our community. Our community is particularly at risk, with an asthma prevalence in the 90-95th percentile, compared to the rest of the state. Our community lacks an air quality monitor, and we are enthusiastic about adding measurements.

If funded, we are looking forward to supporting your project in the following ways:

- Suggesting locations to place sensors.
- Inviting your team to continue to present at city council meetings to help identify sensor hosts and to discuss results.

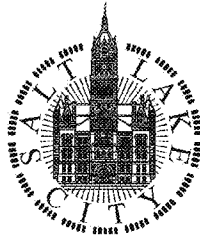
We are looking forward to working with your team.

Sincerely,

A handwritten signature in black ink that reads "Dan W. Peay". The signature is fluid and cursive, with the first letters of each word being capitalized and prominent.

Dan Peay, Mayor
Magna, UT

ERIN MENDENHALL
Mayor



DEBBIE LYONS
Director

DEPARTMENT OF SUSTAINABILITY

March 18, 2022

Dr. Nancy Daher
Research Scientist, Utah Division of Air Quality
195 N 1950 W
Salt Lake City, UT 84116

Subject: Letter of Support for Proposal "Addressing Air Pollution Inequities in the Salt Lake Valley through Community-Engaged Particle Monitoring"

Dear Dr Daher,

Salt Lake City's Sustainability Department is pleased to support your proposal to the US EPA entitled "Addressing Air Pollution Inequities in the Salt Lake Valley through Community-Engaged Particle Monitoring". This proposal aligns with the Salt Lake City Sustainability Department's mission to protect natural resources, reduce pollution, and establish a path toward greater resiliency for everyone in our community.

The Salt Lake Valley faces severe air quality challenges, with PM_{2.5} often exceeding the 24-hr National Ambient Air Quality Standard. Underserved areas in the valley are disproportionately affected by heavy-duty vehicle traffic, dust from the Great Salt Lake and emissions from Utah's new Inland Port. These burdens are likely to further increase due to population growth and ongoing development of the Inland Port.

We appreciate the value of improved monitoring in these communities to help inform effective policies. If funded, we anticipate supporting your project in the following ways:

- Guiding the placement of sensors.
- Providing feedback on your air quality maps and how you are communicating measurements to the public.
- Publicizing your real-time, air quality maps and results through our network of partners.
- Having a representative on your community steering committee, if desired.

We are looking forward to working with you on this project.

Sincerely,

A handwritten signature in cursive script, appearing to read "Debbie Lyons".

Debbie Lyons
Director



UCAIR Board

Emily Schilling, Chair
Jon Cox, Chair-Elect
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Jennifer Robison
Kim Shelley

UCAIR Staff

Kimberly Frost, Executive Director
Emily Paskett, Program Manager
Olivia Niitsuma, Office Manager
195 North 1950 West
Salt Lake City, UT 84116

March 18, 2022

Dr. Nancy Daher
Research Scientist, Utah Division of Air Quality
195 N 1950 W
Salt Lake City, UT 84116

Dear Dr. Daher,

UCAIR would like to enthusiastically support your proposal to the US EPA entitled “Addressing Air Pollution Inequities in the Salt Lake Valley through Community-Engaged Particle Monitoring”. UCAIR is a statewide clean air partnership that focuses on concrete steps that individuals and communities can take to improve our air quality. Utah has made great strides to improve its air quality over the past 10 years, but we face continued challenges associated with our growing population and the drying of the Great Salt Lake. Utah is the fastest growing state in the US, and its population is expected to double by 2050 with the majority of this growth occurring in an already constrained airshed. Our state’s underserved areas of the state bear a disproportionate burden of poor air quality, and these burdens are likely to increase because of increasing heavy-duty vehicle traffic associated with the Inland Port and because of the drying Great Salt Lake, portions of which lie directly upwind of these areas. We appreciate the need for improved monitoring in these communities to help inform policies. I am a member of the Utah Inland Port Community Advisory Council and this project will help the council provide sound guidance to the Port Authority related to our air quality.

We also enthusiastically support continued partnership with your organization, the Utah Division of Air Quality (UDAQ), and with your collaborator, Dr. Kelly. UCAIR relies on the technical expertise of UDAQ and scientists, such as Dr. Kelly, to identify effective strategies to improve air quality, and we then develop strategies to translate this science into actionable strategies for policymakers and individuals. We also appreciate Dr. Kelly’s service on the UCAIR Board and on the State Air Quality Board.

We are looking forward to supporting your project in the following ways:

- Inviting your team to present at our monthly UCAIR partners meeting, which typically has approximately 50 attendees with an interest in air quality. These participants range from industry to non-profits and community members.
- Publicizing your real-time, air quality maps and results through our extensive communication network.
- Assisting with community engagement efforts.
- Helping identify a community member who would be interested in serving on your community steering committee.

We are looking forward to working with your team.

Sincerely,

Kimberly Frost

Kim Frost, Executive Director

UCAIR, Utah Clean Air Partnership



EDUCATION • COLLABORATION • POLICY

Clean air for everyone!

BREATHEUTAH.ORG

Dr. Nancy Daher
Research Scientist, Utah Division of Air Quality
195 N 1950 W
Salt Lake City, UT 84116

March 3, 2022

Dear Dr. Daher,

Breathe Utah is delighted to support your proposal to the US EPA entitled “Addressing Air Pollution Inequities in the Salt Lake Valley through Community-Engaged Particle Monitoring”. Breathe takes a collaborative approach in seeking real solutions to Utah’s air quality problems. We seek long-term, science-based solutions, and we value openness and inclusivity. Although we have made progress in improving air quality, particularly during the winter season, communities in the Salt Lake Valley must grapple with a rapidly growing population, the development of Utah’s new inland port and a shrinking Great Salt Lake, all of which occur in our constrained airshed.

I also serve as a member of Utah’s Inland Port Community Advisory Council, and I would enthusiastically welcome your participation in future council meetings where we could discuss your plans, sensor siting, and results.

We appreciate the expertise of the Utah Division of Air Quality and scientists like your collaborator, Dr. Kelly. Specifically, Breathe appreciates the willingness of DAQ scientists to provide their expertise as Breathe seeks to identify the most effective strategies to improve our air quality. Breathe also appreciates our long-standing relationship with Dr. Kelly including her service on our Advisory Board, service to the state on the Air Quality Board, and efforts on community engagement and outreach. I would like to highlight our work with Dr. Kelly that led to a very successful educational model to develop an air quality sensor from Legos™, a LED light, a photodetector, a fan, and an Arduino board. We have demonstrated this module in numerous teacher workshops, community events, and classrooms, and we were delighted that Dr. Kelly’s team was selected to demonstrate this module at the National Science and Engineering Fair and Expo in 2018.

We anticipate supporting your project in the following ways:

- Connecting our network of educators with the educational materials that your team is developing.
- Publicizing your real-time, air quality maps and results through our network of partners.
- Assisting with community engagement efforts.
- Having a Breathe representative on your community steering committee if desired.

We are looking forward to continued partnership.

Sincerely,

Ashley Miller, Executive Director
Breathe Utah

PO Box 1443, Sandy UT 84091
Breatheutah.org



March 16, 2022

Dr. Nancy Daher
Research Scientist, Utah Division of Air Quality
195 N 1950 W
Salt Lake City, UT 84116

Dear Dr. Daher:

Utah Clean Energy is pleased to support your proposal to the US EPA entitled "Addressing Air Pollution Inequities in the Salt Lake Valley through Community-Engaged Particle Monitoring". Through advocacy, education, and diverse partnerships, Utah Clean Energy advances renewable energy, energy efficiency, and electrification in Utah and the Western US. Utah Clean Energy's work emphasizes energy equity, and we have experience in the underserved communities on the west side of the Salt Lake Valley. Currently, our Energy Access and Equity Associate, Ofa Matagi, is working on two projects in this area, one of which is a collaborative problem-solving project with the US EPA. Utah Clean Energy also serves on the Inland Port Community Advisory Council.

Energy use and air quality are tightly linked, particularly in Salt Lake Valley's constrained airshed. Utah Clean Energy would welcome your participation at future Inland Port Community Advisory Council Meetings to discuss your plans, sensor siting, and results. We are also happy to share our experience and community contacts. Dr. Kelly, your collaborator, has presented and provided valuable information to this council. We also appreciate the Utah Division of Air Quality's role as a trusted source of air-quality and pollution-mitigation strategies.

We are looking forward to working with you on your important project.

Sincerely,

A handwritten signature in cursive script that reads "Sarah Wright".

Sarah Wright, Executive Director
Utah Clean Energy

Dr. Nancy Daher
Research Scientist, Utah Division of Air Quality
195 N 1950 W
Salt Lake City, UT 84116

March 22, 2022

Dear Dr. Daher,

I am an Associate Professor in the Geosciences Department at Salt Lake Community College, and I am co-PI of a National Science Foundation Critical Zone Project DUST² “Dust Across a Desert-Urban-Summit Transect”. As part of this project I have developed an outreach program named *DustKids* with the Boys and Girls Clubs of Greater Salt Lake. DustKids engages elementary and middle-school students in understanding the importance of the Great Salt Lake to our ecosystem and the impacts of dust. My research focuses on understanding the sources, transport, and air quality impacts of dust storms in the western US.

As a researcher I am enthusiastic about collecting additional measurements in the vicinity of the Great Salt Lake, which will enhance our understanding of dust sources and transport, and as an educator I am enthusiastic about integrating the outreach materials developed under this project into *DustKids*.

In summary, I look forward to working with your team on your proposed project “Addressing Air Pollution Inequities in the Salt Lake Valley through Community-Engaged Particle Monitoring”.

Sincerely,



Maura Hahenberger, PhD
Associate Professor, Salt Lake Community College
Co-PI, Dust across a Desert-Urban-Summit Transect (DUST²)



Dr. Nancy Daher
Research Scientist, Utah Division of Air Quality
195 N 1950 W
Salt Lake City, UT 84116

March 3, 2022

Dear Dr. Daher,

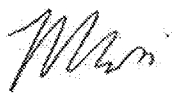
The University of Utah Bennion Center is delighted to collaborate on your proposal to the US EPA entitled "Addressing Air Pollution Inequities in the Salt Lake Valley through Community-Engaged Particle Monitoring". The University of Utah's Bennion Center's mission is to inspire and mobilize people to strengthen communities through learning, scholarship, and advocacy. I direct the University of Utah's Bennion Scholars Program and teach *Introduction to Civic Leadership*. Bennion Scholars apply their academic interests to meet a real social concern through a capstone project with a Community Partner and Faculty Mentor. Dr. Kelly, your collaborator on this project, has a strong track record of mentoring both Bennion Scholars and students in *Introduction to Civic Leadership*. Specifically, she has mentored students who developed outreach materials for K-12 students to understand the effectiveness of face masks in reducing aerosol transmission and who worked to develop outreach materials regarding air quality in underserved communities in the Salt Lake Valley. I am delighted to build on these collaborations.

I anticipate collaborating with your team in the following ways:

- Connecting you with a team of students in *Introduction to Civic Leadership* who would contribute to the proposed project by participating in community listening sessions, attending community council meetings, and working with communities to host low-cost sensors.
- Offering Bennion Scholars an opportunity to devote their capstone project to working with your team. This capstone project would align with a student's skills and interests, but I envision a number of ways in which capstone projects could complement your proposed work, such as understanding how communities engage with your results or investigating associations between your highly resolved air quality measurements and heavy-duty vehicle counts.

We are looking forward to continuing to work with you and your team on this project.

Sincerely,



Megan Medina
Bennion Scholars, Senior Program Manager



Dr. Nancy Daher
Research Scientist, Utah Division of Air Quality
195 N 1950 W
Salt Lake City, UT 84116

March 21, 2022

Dear Dr. Daher,

We would like to support your proposal to the US EPA entitled "Addressing Air Pollution Inequities in the Salt Lake Valley through Community-Engaged Particle Monitoring" by cost-sharing some of the student labor needed to conduct the survey. We co-direct the National Institutes of Environmental Health Sciences (NIEHS)-funded HAPPIEST (**H**ealth, **A**ir **P**ollution and **P**opulation **I**nitiative in **E**ducation and **S**cience **T**raining) program (<https://nexus.utah.edu/research/project-happiest.php>). This program supports an evidence-based ten-week summer training program for undergraduate students from underrepresented backgrounds in the area of environmental health science. Each year (2021 through 2025), HAPPIEST recruits students and mentors to form four research teams, each comprised of two undergraduate students, one graduate student training coordinator, and at least one faculty mentor. Teams work on locally relevant air pollution and health research projects. Eight undergraduate students are funded each summer, for a total of forty, between Summer 2021 and Summer 2025.

If this award is selected for funding, we will recruit a HAPPIEST team in Summer 2023 of two undergraduates, both bilingual in English and Spanish, and one graduate student, to work with Dr. Kelly and both of us on the survey. When selecting students, we will give preference to undergraduate students from the communities being surveyed. The HAPPIEST students will participate in the survey research data collection during the summer, alongside the grant-paid students. Bringing in these additional HAPPIEST student research assistants--not paid by this EPA grant--will allow us to obtain additional surveys to reach our sample size target. Importantly, it also provides the HAPPIEST students with an authentic research experience with local relevance and important policy implications.

We are looking forward to continue to work together.

Sincerely,

Sara Grineski
Professor of Sociology and ENVST
Director of Undergraduate Studies in Sociology
HAPPIEST Co-Director
University of Utah
sara.grineski@soc.utah.edu

Timothy Collins
Professor of Geography and ENVST
Director of Undergraduate Studies in Geography
HAPPIEST Co-Director
University of Utah
tim.collins@geog.utah.edu



State of Utah

SPENCER J. COX
Governor

DEIDRE HENDERSON
Lieutenant Governor

Department of
Environmental Quality

Kimberly D. Shelley
Executive Director

Ty L. Howard
Deputy Director

March 22, 2022

Dr. Nancy Daher
Research Scientist, Utah Division of Air Quality
195 N 1950 W
Salt Lake City, UT 84116

Dear Dr. Daher,

The Environmental Justice committee at the Utah Department of Environmental Quality is pleased to support your proposal to the US EPA entitled "Addressing Air Pollution Inequities in the Salt Lake Valley through Community-Engaged Particle Monitoring." Underserved areas in the Salt Lake Valley are disproportionately affected by heavy-duty vehicle traffic, dust from the Great Salt Lake and emissions from Utah's new Inland Port. With a rapidly-growing population and ongoing development of the Inland Port, these burdens are likely to further increase.

We appreciate the value of enhancing monitoring in these underserved communities, and partnering with local community groups to ensure their equitable representation in environmental decision-making. This project aligns well with the objectives and priorities of the committee.

If funded, we anticipate supporting your project by coordinating efforts, sharing resources, and sustaining the community partnerships, developed through this work, beyond the lifetime of the project.

We are looking forward to working with you on this project.

Sincerely,

Christopher Otto

Christopher Otto (Mar 23, 2022 15:11 MDT)

Christopher Otto

Director of Policy, Planning & Public Affairs
Utah Department of Environmental Quality



WWW.PURPLEAIR.COM | CONTACT@PURPLEAIR.COM

A Citizen Science Air Quality Monitoring Network

Dr. Nancy Daher
Research Scientist, Utah Division of Air Quality
195 N 1950 W
Salt Lake City, UT 84116

Mar 10, 2022

Dear Dr. Daher,

PurpleAir is happy to support you and your team on the proposal to the US EPA entitled “Addressing Air Pollution Inequities in the Salt Lake Valley through Community-Engaged Particle Monitoring.” We initially launched our community air-monitoring platform to understand and address the air quality challenges of the Salt Lake Valley, and we have been delighted to see how it has grown. We currently have hundreds of sensors in Utah and more than thirty thousand worldwide.

PurpleAir appreciates your efforts to understand air quality in our underserved communities. We are happy to continue partnering with you and your collaborator, Dr. Kelly, with whom we had partnered since 2016 when she evaluated the performance of our first sensor (PAI).

If funded, we intend to support your team by continuing to allow access to our measurements through our public API. We are also planning to donate three PurpleAir sensors to co-locate at your Beck Street location. This location is affected by a nearby gravel operation.

We are looking forward to partnering with you.

Sincerely,

Adrian Dybwad
Founder, PurpleAir.com
Tel: 800-474-0696
Email: adrian@purpleair.com

I. Cover Page

Project Title Addressing Air Pollution Inequities in the Salt Lake Valley through Community-Engaged Particle Monitoring (API-SLV)

Applicant Utah Division of Air Quality (UDAQ), 195 N 1950 W, Salt Lake City, UT 84116
Nancy Daher, Ph.D; 385-377-6017; ndaher@utah.gov
DUNS number: 8260010590000

Set aside no set-aside

Description of Applicant Organization UDAQ is committed to safeguarding and improving Utah's air through balanced regulation. Current projects include the development of O₃ SIP and ambient monitoring/health risk assessment of ethylene oxide from medical sterilizers. A summer-time ambient monitoring O₃ study is also being planned with NOAA, EPA and local researchers.

Project Partners University of Utah, Prof. Kerry Kelly; Utah Clean Cities, Tammie Bostick; Friends of the Great Salt Lake, Katie Newburn; Other (Inland Port Authority, Utah Department of Health, Salt Lake health department, various community councils, cities, advocacy groups, schools, grass root organization. Refer to Table 1 for a complete list).

Project Location West-side communities of the Salt Lake Valley, Utah: Poplar Grove Salt Lake City (SLC) 84104; Glendale SLC 84104; Westpointe SLC 84116; Rose Park SLC 84116; Fairpark SLC 84116; Beck St. area of Capitol Hill SLC 84116; Magna 84044; West Valley 84128 & 84120

Air Pollutant Scope PM_{2.5}, PM₁₀

Budget Summary

EPA Funding Requested	Total Project Cost
\$285,379	\$285,379

Leveraged support - Purple Air three donated sensors: \$735, EPA EJ grant to Utah Clean Cities: \$75,000, NSF grants to develop the sensing & data integration infrastructure in the SLV: \$850,000.

Project Period October 1 2022 – September 30 2025

Project Description Enhancing PM_{2.5} and PM₁₀ monitoring in underserved communities by integrating low-cost particle measurements with community partnerships. We will engage communities through our community steering committee, community meetings, surveys, listening sessions, outreach modules, and air quality visualizations and alerts. This work will help strengthen relationships between impacted communities and regulatory agencies, leading to increased trust, effective collaboration, shared decision-making, and development of mitigation strategies.

II. Workplan

Section 1 – Project Summary and Approach

A. Overall Project

Background and Objectives. Utah is the fastest growing state in the US, and the Salt Lake Valley (SLV), is the most densely populated region of this state. The SLV periodically experiences the worst air quality in the nation as a result of winter-time cold air pools, wildfires, and dust storms. It frequently exceeds the PM_{2.5} 24-hour national ambient air quality standard. The SLV is facing increasing air quality burdens associated with its rapidly growing population, the development of Utah's new Inland Port, increasing vehicle miles traveled and transportation emissions, gravel operations, and desiccation of the Great Salt Lake (GSL). Summer-time PM_{2.5} levels in the SLV are increasing¹. The GSL, which is located to the northwest of the SLV, is at historically low levels, with more than 750 mi² of exposed lakebed, some of which contain elevated levels of heavy metals². Under appropriate meteorological conditions, portions of this exposed lakebed produce substantial dust plumes, and the prevailing winds transport this dust directly into the SLV². Pollution levels in the SLV are also not distributed uniformly. Communities in SLV's northwest (NW) quadrant are disproportionately affected by particle pollution because of their proximity to

gravel operations, a mine tailings pond, heavy-duty diesel traffic, and the GSL's exposed lakebed. Left unchecked these impacts are likely to increase, placing additional health impacts on these already over-burdened communities.

The Utah Division of Air Quality's (UDAQ's) ambient air monitoring for PM_{2.5} and PM₁₀ are geospatially sparse. Most monitoring stations are located on the eastern side of the SLV and are not representative of PM_{2.5} and PM₁₀ levels in SLV's NW quadrant, home to several under-resourced communities (Figure 1). Previous studies have demonstrated elevated PM_{2.5} levels in these communities³⁻⁵. Although UDAQ's monitoring network is supplemented by low-cost sensor networks (PurpleAir (PA) and the University of Utah's [UU] /Tellus's AirU) and measurements on public transportation systems equipped with PM_{2.5} monitors⁵, few PM_{2.5} measurements are available in SLV's NW quadrant (Figure 1). Furthermore, few transit-based measurements cover the NW side of the SLV, and these are limited by their fixed route and constrained operating hours, and only offer a snapshot of concentrations in time. PM₁₀

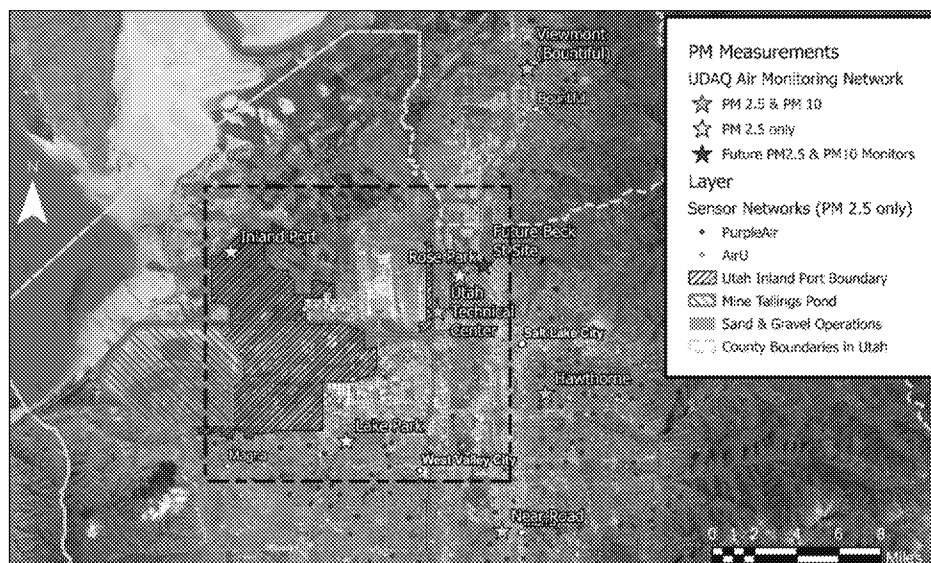


Figure 1. PM_{2.5} and PM₁₀ stationary monitoring sites and sensors in the Salt Lake Valley. Dashed line corresponds to study area. Also shown are nearby area emission sources (Great Salt Lake, airport, gravel operations, tailings ponds, Inland Port).

measurements are even more limited, with few UDAQ monitors and none located close to the GSL, Inland Port, gravel operations or tailings ponds, important sources of PM₁₀. Enhanced monitoring of PM_{2.5} and PM₁₀ in underrepresented areas close to these sources is needed.

The objective of the proposed study (API-SLV) is to enhance PM_{2.5} and PM₁₀ monitoring in underserved communities on the NW side of the SLV, in support of EPA's Strategic Plan, Goal 4/Objective 4.1, "Improve Air Quality and Reduce Localized Pollution and Health Impacts". API-SLV will leverage existing state and community air quality monitoring networks, and expertise to understand PM_{2.5} and PM₁₀ levels and sources in these communities. It will address measurement gaps by providing accurate, near real-time measurements throughout this area by adding more PM_{2.5} sensors and low-cost PM₁₀ monitoring to complement the extremely limited UDAQ measurements. Close community partnerships will ensure that the project addresses community needs, and our team is committed to a community-engaged approach. Specifically, local community members and groups will guide the project design, sensor siting, data collection and presentation of results as well as outreach and mitigation strategies. Specific objectives include:

- Developing community-specific assessments of PM_{2.5} and PM₁₀ air pollution levels
- Enhancing PM_{2.5} and PM₁₀ monitoring in underserved areas
- Identifying air pollution hotspots

- Providing communities with reliable, meaningful, localized, real-time $PM_{2.5}$ and PM_{10} measurements
- Increasing community awareness about $PM_{2.5}$ and PM_{10} air quality challenges
- Building a sustainable foundation of trust between concerned communities and regulatory agencies
- Translating findings into mitigation action through partnerships between communities and decision makers

Sensor, network, data assimilation, screening, uncertainty and validation. API-SLV will generate accurate, near real-time visualizations of PM levels at all locations in our study area. It leverages measurements from three existing PM sensor networks (UDAQ, UU/Tellus's AirU, and PurpleAir [PA]) and integrates rigorous quality assurance (QA), data-fusion algorithms, and engaging visualizations. This infrastructure was originally developed for the SLV under a NSF grant, and the back-end services, automated QA, and visualizations have been transitioned to Tellus, Inc. These visualizations, in the form of maps (Figure 2), are available through a public-facing website. The UU *demonstrated the performance of the PM sensors, the infrastructure, and the accuracy of the $PM_{2.5}$ estimate maps in several peer-reviewed publications^{4,6-8}. Comparing $PM_{2.5}$ concentrations estimated from our infrastructure to FEM measurements during a SLV inversion event in 2019 revealed a nRMSE of 20.2–21.3% (leave one out cross validation at two different UDAQ sites). Figure 3 illustrates the infrastructure, and the following sections detail the sensing nodes, infrastructure, QA, data-fusion, and visualizations.*

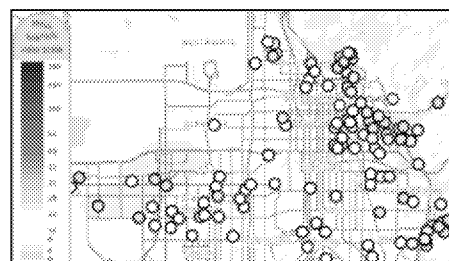


Figure 2. Visualization of $PM_{2.5}$ concentrations in the northern SLV Valley, 12/1/2021, 9:30 am MST.

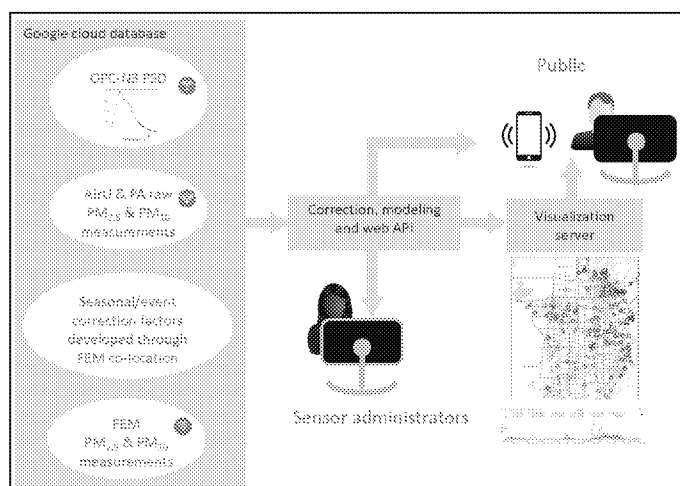


Figure 3. Overview of PM measurement infrastructure.

(LCS, AirU, AirU⁺, and PA II) as well as UDAQ FEM/FRMs. The *AirU node* measures $PM_{2.5}$ concentration with the Plantower PMS3003. It includes WiFi (2.4GHz) and BLE4.0 capabilities as well as temperature, relative humidity (RH), GPS, oxidizing/reducing gas species (Figure 4). Nodes communicate wirelessly to a Google Cloud Platform (GCP) database via secure MQTT messaging. Devices update their credentials every 6 hours with encrypted messages. Over-the-air firmware updates are pushed as needed. There are currently 7 AirU sensors in the study area. The *PA node* measures $PM_{2.5}$ concentration with two PMS 5003 sensors mounted in one housing. It contains a BME280 pressure, temperature and humidity sensor, and an ESP8266 chip. It communicates over WiFi to their cloud database. Their measurements are available through a public API, and PA is supporting this project



Figure 4. AirU sensing node.

allowing access to their measurements and donating three sensors (see letter). There are 38 PA sensors in the study area, 80% of which are located in West Valley (Figure 5).

LCS Sensor Performance. The UU has maintained three PA IIs and three AirUs at UDAQs Hawthorne site and has *demonstrated* that, after applying seasonal correction factors (QA plan), AirUs and PAs *meet EPA's performance targets* (Table ES2) for PM_{2.5} concentrations when seasonal mean PM_{2.5} concentrations exceed 5 µg/m³^(4,6,8). The Plantower PMS in the AirU and PA nodes report PM₁₀ measurements and particle size distributions; however, *they do not perform well for PM₁₀ or wind-blown dust, and are incapable of measuring particle size distributions*^{9,10}. Consequently, we selected the Alphasense OPC-N3 for integration into the AirU. The OPC-N2 has demonstrated good performance in the field for PM₁₀ (coefficient of variation (CV) < 25% and coefficient of determination (R²) > 0.75 with FEM PM₁₀ measurements when RH was below 85%)¹¹. RH in the SLV rarely exceeds 85%, and RH compensation can be developed¹¹. Note the only difference between the OPC-N3 and OPC-N2 is the communication protocols (Alphasense, personal communication).

PM₁₀ measurements. The AirU⁺ will measure PM_{2.5} with the PMS 3003 and PM₁₀ with the OPC-N3. The AirU⁺ utilizes the AirU's board's SPI connection port and communication infrastructure. Alphasense provides the libraries necessary to integrate the sensor measurements into an IoT platform, such as the AirU. In addition to using the direct measurements of PM₁₀ from the UDAQ FEMs and the AirU⁺ nodes, we will estimate PM₁₀ concentrations using the particle size distribution from the OPC-N3s and the co-located AirU and PAII to develop an appropriate AirU or PA PM₁₀ to PM_{2.5} ratio, using the method described by Sugimoto et al. 2016¹².

Data correction, screening, fusion, and visualization. Optical PM sensors, like the those in this proposal, require a correction factor (CF) to convert particle counts and light scattering, respectively, to particle mass concentrations. We will continue to develop and apply seasonal and event-specific CFs for the AirU, AirU⁺ and PA (QA plan). We will also provide rigorous automated data screening to remove outliers and sensors that have drifted (QA plan). The screened and corrected PM sensor measurements are incorporated into a Gaussian Process (GP) regression model, which includes customized kernel functions that incorporate distance, time and elevation to obtain continuous-valued spatio-temporal estimates of PM concentration throughout study region, complete with a confidence value describing the accuracy of the measurement. This GP model allows the construction of dense PM colormaps. The visualizations of PM concentration use the EPA AQI color scheme, because of its familiarity to the public (recognizing that this color scheme relies on 24-hour concentrations). This infrastructure has been demonstrated and published^{4,7}. We will also add overlays to the maps for wind direction and wildfires.

Data access and storage. The public will have access to the real-time visualizations, a week of historical visualizations, and individual sensor PM measurements through a public-facing website. More extensive data will be available to key personnel and partners through a dashboard, and to the public through an API, which exposes a number of routes to access data by sensor ID, location (with radius), aggregation type, and datetime period. The data include raw, LCS measurements, flags, LCS measurements with CFs applied, CFs (and time periods), PM_{2.5} and PM₁₀ gridded estimates used for the maps, PM estimates at any location and any time period (within the study area and period). The data are stored in a private and secure Google Cloud Platform (GCP)-hosted SQL database optimized for time-series storage transactions (Google BigQuery).

Instant, localized, air quality alerts. We will develop an alert system that allows individuals to sign up for location-specific alerts (via text or email) using API-SLV's location-specific PM

concentrations. The Utah Health Department will guide the crafting of the alert messages and thresholds (see attached support letter).

B. Project Significance

The proposed work will focus on communities on the NW side of the SLV. These include Poplar Grove, Beck St. area of Capitol Hill, Westpointe, Rose Park, Fairpark, Glendale, Magna and West Valley (Figure 5). Given their close proximity to the GSL, new Inland Port development, heavy-duty vehicle routes, and airport, these communities are at increased risk of PM_{2.5} and PM₁₀ exposure, and experience elevated rates of asthma (EPA EJ screen). Communities near Magna and Beck Street (Capitol Hill) are also at increased risk of PM₁₀ exposure due to emissions from nearby mine tailings and gravel operations, respectively. API-SLV will help address air pollution inequities impacting these underserved communities by

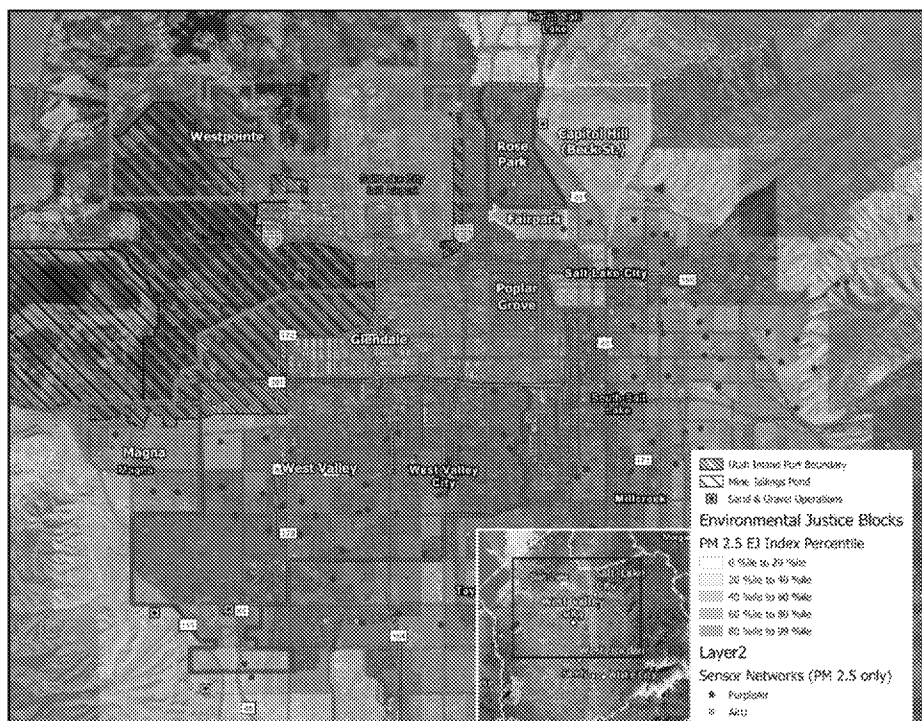


Figure 5. Target communities and PM_{2.5} Environmental Justice (EJ) index (in state percentile), nearby emission sources (Inland Port, Great Salt Lake, airport, gravel operations, tailings pond) and PM_{2.5} sensor locations. EJ data retrieved from US EPA EJ mapping and screening tool.

providing meaningful, accurate, and localized air quality information in near real-time through easy-to-interpret visualizations. It will help vulnerable populations in these neighborhoods, such as asthmatics, children and elderly populations, reduce their exposure risk. API-SLV will also benefit local schools, daycare and preschool centers who can refer to the air quality visualizations, instant air-quality alerts, and guidance developed with the Health Department on when to schedule outdoor activities. Health researchers and the Health Department, specifically its Asthma and Environmental Epidemiology program coordinators (see letter), can use the highly resolved PM_{2.5}/PM₁₀ concentrations to track associations between air quality and health effects (e.g. asthma incidences) and to improve public health messaging. Educators will also benefit from the educational modules developed under this work, which can sustain community outreach beyond the project.

Section 2 - Community Involvement

From project inception through completion, community partners will guide the project design, sensor siting, data collection, presentation of results, outreach activities, and target mitigation strategies. We will leverage our tight community connections to continue to engage the community.

A. Community Partnerships

API-SLV has strong community support. Table 1 highlights our partners, their expertise and their primary roles. By working together, partners can join efforts, share resources and knowledge to develop mitigation strategies and unified messaging that can be more effectively translated into policy. Details on partner roles, recent collaborations and benefit from the collaborative partnerships can be found in the letters.

Table 1. List of community partners, their expertise and roles.

Partner - expertise	Role
Utah Clean Cities (UCC)* - community engagement, reducing transportation impacts	<i>Inland port focus:</i> Participate in steering committee, assist with survey development and identifying community concerns, lead listening sessions, partner on UCC's EPA EJ grant listening sessions and implementing the port collaborative toolkit, provide guidance on sensor siting, recruit sensor hosts, and co-develop outreach materials.
Friends of the Great Salt Lake (FRIENDS)* - GSL environment, community engagement	<i>GSL focus:</i> Participate in steering committee, assist with survey development and identifying community concerns, partner on listening sessions, recruit community members for steering committee and sensor hosts, gather input from community members to assess awareness and identify concerns and priorities, lead education and volunteer events.
UU* - LCS sensors, community outreach, EJ and surveys	<i>Measurements, survey, and outreach:</i> Kelly - co-lead community outreach, LCS calibration, sensor deployment, QA, project website, implement air quality alerts, outreach development and implementation, measurement analysis. Collins/Grineski - survey design/implement, IRB approval.
Tellus* - sensor networks, data visualization, software	<i>Sensors, backend, automated QA, and visualizations:</i> add PM ₁₀ measurements to AirU and visualizations, perform automated QA, manage backend, provide sensor data management, add map overlays, support air quality alerts.
State Health Department – community health, policy implementation	<i>Community health and policy:</i> Guide on health messaging and alerts, disseminate results through the department's Air Quality workgroup, Asthma Task Force, and Environmental Epidemiology program, guide sensor placement, share air-quality complaints, recruit participants for automated air quality alerts, sensor hosting, listening sessions, steering committee.
Inland Port Authority (IPA) and advisory council – policy	<i>Policy implementation for Inland Port:</i> Support sensor infrastructure with WiFi, serve as a mechanism to implement policies that grow from SLV-API results, guide sensor placement, provide feedback on results presentation, and provide a venue for results dissemination.
Salt Lake County Health – community health	<i>Community and policy:</i> Guidance on health messaging, access to research-grade measurements for validation, assist with dissemination of results.
Community Councils** – community needs and priorities	<i>Community:</i> Poplar Grove, Capitol Hill, and Glendale Community councils - Help with sensor siting; advertising survey; recruit: sensor hosts, listening-session participants, steering committee member; provide feedback on: results, automated alerts, developing mitigation strategies.
UCAIR** – air quality and community	<i>Air quality NGO:</i> Help with community engagement and invite to present at a UCAIR partner meetings (50+ community partners), member of Inland Port community advisory council
Breathe** – air quality and community	<i>Air quality NGO:</i> Help with community engagement and linking to their extensive network of K-12 teachers. Member of Inland Port community advisory council.
Utah Clean Energy** – energy equity	<i>Energy NGO:</i> Help with community engagement and linking to their energy equity efforts. Member of the Inland Port community advisory council.
DUSTKids** – education engagement	<i>Education and outreach:</i> Integrating our results/teaching modules into their program with the Boys & Girls clubs of SLC.
UU Bennion Center and HAPPIEST** – community engagement and EJ	<i>Education and outreach:</i> UU Student scholars participate in community events, assist with surveying.
UDEQ EJ Committee – community engagement	<i>Outreach:</i> sustain relationships between policy-makers and partnerships beyond the project and facilitate community engagement in UDEQ policy-making boards and committees.
Purple Air** - sensors	Provide three sensors and access to their sensor measurements through their API.
Salt Lake City**- Sustainability department	<i>Community and policy:</i> Guidance on sensor placement, disseminating results, serving on steering committee, mechanisms to implement mitigation strategies.
Magna City	<i>Community and policy:</i> guide sensor siting, recruit sensor hosts, venue for results dissemination

* Paid partnership. **Recent collaborator. NGO: non-governmental organization.

Maintaining and sustaining relationships and infrastructure. API-SLV builds on existing relationships between UDAQ, Dr. Kelly, UCC, FRIENDS, grass-roots organizations, and the westside community (letters). UDAQ is committed to ensuring equitable community representation and shared decision-making power. The collaborative partnerships developed/enhanced through API-SLV will allow these community members to have their voices heard (i.e., through service on DAQ committees/boards, and to Inland Port decision makers, see IPA letter). UDEQ's EJ committee is committed to maintaining these partnerships beyond the length of the project (see letter). The monitoring infrastructure will continue to be supported through research and foundation grants. Dr. Kelly has a strong track record of funding for maintaining this network and for taking the sensor network into new directions (i.e., emerging pollutants).

B. Community Engagement

Community Needs Assessment. API-SLV will identify the communities' air quality concerns and priorities through a needs assessment survey, focus groups, and listening sessions. We will conduct an IRB-approved probability-based, structured social survey of westside residents focused on their perceptions, attitudes and behaviors pertaining to air quality, the GSL, and the Inland Port. The survey will be available in Spanish and English, and will take about 20 minutes. We will use a multi-pronged approach to maximize the distribution of the survey without compromising representativeness, including distribution of a survey link through the Nextdoor app and obtaining a random sample of addresses within the study area, with name, phone number and email address, from a marketing research firm. The approach will involve 1) emailing the survey link; 2) calling the households to conduct the survey over the phone; and then 3) sending teams of two students to the home to administer the survey face-to-face using digital tablets. The goal is to obtain completed surveys from 700 households, each of which will receive a \$10 incentive. Community input from the survey will help identify locations of greatest concern, inform sensor siting and identify sensor hosts. Input from the focus groups and listening sessions with community members and leaders will help refine the project outputs, i.e., on air quality maps and data communication. These activities will continue throughout the lifetime of the project and different communities will be targeted each time. The project team will coordinate these activities with their partners, including Utah Clean Cities (UCC), who recently received a US EPA EJ grant ("Supporting Near-Port Communities in Addressing Harmful Air Quality Impacts") to engage communities near the Inland Port (grant does not include measurements). API-SLV and UCC will share resources and best practices, such as UCC's experience with EPA's Community Port Collaborative Toolkit and their community listening sessions.

Community Steering Committee. API-SLV will recruit a Community Steering Committee (~ 12 members) to define the project goals, provide recommendations on data communication, develop mitigation actions to reduce PM exposure and pollution sources, and guide key project decisions. Members will have diverse backgrounds, knowledge and experiences, such as air quality advocates, educators, health officials, community council members and concerned residents. This will help ensure equitable community representation and shared decision-making power. The committee will meet on a quarterly basis throughout the project and more frequently, as needed. API-SLV will provide a stipend to facilitate participation of committee members.

Sensor Hosting and Training. Through community events, survey results, listening sessions and connections with our partners, community members will be recruited to host sensors. A team of students will assist hosts with sensor installation, configuration, and data access. For hosts who prefer to install the sensors themselves, API-SLV will provide instructions and YouTube videos (in both English and Spanish) on installation, configuration, data access, and trouble shooting.

Community Events and Presentations. API-SLV will have a robust outreach program that includes participating in community events and presenting to local organizations, recruiting sensor hosts and steering committee members, sharing findings and seeking recommendations on data communication and mitigation action. The outreach materials will be available in English and other primary languages used in the target communities. Our team has strong existing relationships with community groups, such as community councils, school districts, GSL State Parks, Inland Port Authority, and grass root organizations (support letters). We will also participate in the Utah Department of Health Air Quality workgroup and UDAQ stakeholder meetings (Air Quality Advocates, Air Quality Board), UCAIR partner's meetings and the legislature's Clean Air Caucus. The team will coordinate with Utah's Department of Environmental Quality (UDEQ)'s EJ committee. UDAQ and partners will advertise API-SLV's activities through their social media.

Educational Modules. API-SLV will engage community members in classrooms and at community events by leveraging outreach activities organized through the UU, FRIENDS, Breathe Utah and DUSTKids (see letters). These organizations have a strong track record of developing engaging activities and in working in NW SLC. Breathe Utah and the UU have developed award-winning outreach activities and will use their strong social media to promote events.

Section 3 - Environmental Justice and Underserved Communities

API-SLV focuses on communities on the NW side of the SLV, which are disproportionately impacted by environmental and health burdens (see Section 1.B, Figure 5). Because of their proximity to the GSL, new Inland Port, heavy-duty vehicle routes, airport, mine tailings pond, and gravel operations, these communities are at increased risk of exposure to PM_{2.5} and PM₁₀. With an EJ index of predominantly 80th percentile or greater for PM_{2.5} (compared to state), these communities are more vulnerable to PM_{2.5} pollution than the rest of Utah's population (Figure 5). Moreover, communities in these areas are predominantly low-income, and minority population is

greater than 80% in most of these neighborhoods (Figure 6). These socioeconomically challenged communities, which include several schools, also have higher incidences of COVID-19 compared to more affluent and less diverse neighborhoods¹³.

By establishing a sustainable community-

engaged monitoring platform, the disproportionately higher PM_{2.5} and PM₁₀ exposure levels affecting underserved communities in the SLV can be reduced through changes in policies (e.g. transportation planning, outdoor school recess, IPA policies) and modifying daily activities (e.g.

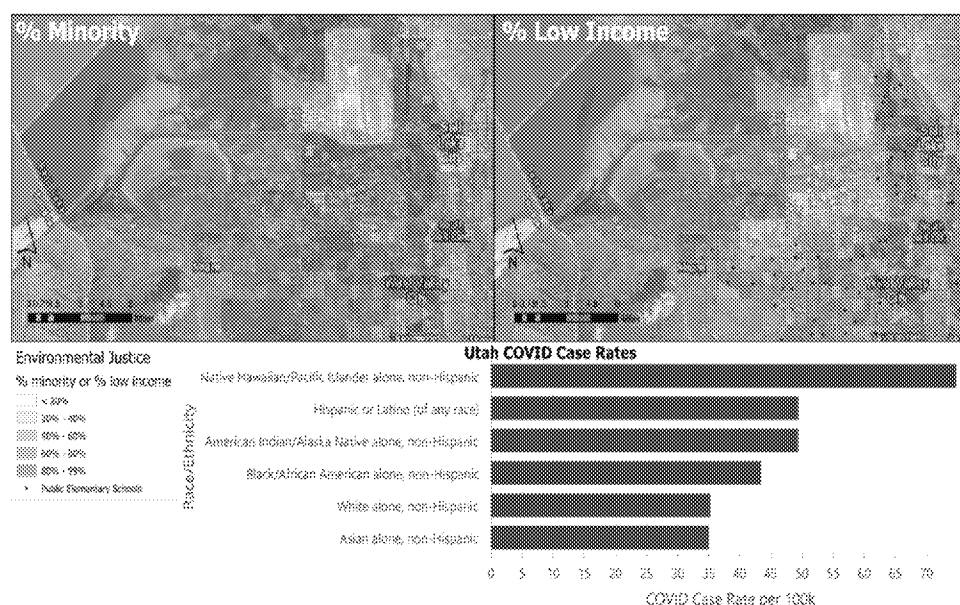


Figure 6. Percent minority and low income in target communities. Cumulative COVID case rates (Mar. 2020- Feb. 2022) per race/ethnicity are also shown.

outdoor exercise, commuting). The project’s results will also help inform environmental advocacy groups, policy makers, and regulators tasked with making decisions related to new development, preservation of water levels in the GSL and health of nearby communities. In fact, because Utah is beginning development of their new Inland Port in the SLV, *the project and partners are very well positioned to positively influence significant policy decisions* (IPA letter). The project’s equitable and inclusive community steering committee will help remedy the underrepresentation of these underserved communities in environmental decision making.

Section 4 - Environmental Results—Outcomes, Outputs and Performance Measures

A. Expected Project Outputs and Outcomes

Table 2. List of expected project outputs and outcomes.

Outputs	Outcomes		
	Short-Term	Mid-Term	Long-Term
<ul style="list-style-type: none"> • Deployment of 40 PM_{2.5} and 10 PM₁₀ sensors in target communities • Community-specific assessments of PM_{2.5} and PM₁₀ levels and challenges • Availability of real-time, localized PM_{2.5} and PM₁₀ measurements (web and instant, air-quality alerts) • Development of a community steering committee • Community empowerment and robust partnerships between stakeholders and policy makers • Development of outreach materials and teaching modules • Presentations, community meetings, reports, surveys 	<ul style="list-style-type: none"> • Improved understanding of the impact of PM emission sources on local air quality, including emissions from the Great Salt Lake, Inland Port, gravel operations • Better understanding of PM_{2.5} and PM₁₀ air quality challenges at the community level • Increased community awareness • Clear, transparent and increased access to air quality information 	<ul style="list-style-type: none"> • Community and individual action to reduce source emissions and personal exposure to PM levels • State and IPA action to mitigate PM emissions and address environmental justice concerns 	<ul style="list-style-type: none"> • Reduction in emissions and ambient levels of PM₁₀ and PM_{2.5} • Reduction in human exposure to PM_{2.5} and PM₁₀ • Improved health outcomes (i.e., lower asthma rates) in our partner communities

API-SLV will enhance PM_{2.5} and PM₁₀ monitoring in SLV’s EJ communities. This will equip communities and individuals with the scientific knowledge they need to take action to limit their exposure to air pollution and to advocate for their community with government and stakeholder organizations. Also, by providing transparent and timely access to air quality information through an engaging and easy to understand real-time (i.e., maps), instant air-quality alerts, as well as a public API that allows customizable and comprehensive data downloads, this project will empower communities to independently evaluate their local air quality. API-SLV will help strengthen relationships between impacted communities and policy makers, which will lead to increased trust, effective collaboration and shared decision-making, which will ultimately help reduce community exposure to PM_{2.5} and PM₁₀.

B. Performance Measures and Plan

API-SLV’s progress will be evaluated by tracking the degree of community engagement. This includes tracking the number of participants in community activities and survey respondents. This will also be assessed by tracking metrics of the project website and alert notification system (e.g. number of visitors and users), and by regularly seeking feedback from community members through listening sessions/focus groups. The success of the community partnerships will also be assessed by tracking the number of organized outreach events, assessing the degree of commitment of the community partners and ability to sustain meaningful collaborations and leverage resources. Performance will also be evaluated by assessing the degree of success in forming an equitable

committee, with a balanced representation of the community, and by tracking the number of action items/outcomes (e.g. mitigation strategies) that result from the committee meetings. The number of sensors deployed, quality of the sensors data (outliers, precision, completeness, drift, sensor uptime) and timely execution of the proposed tasks will also be assessed.

C. Timeline and Milestones

Table 3.Project timeline and milestones.

	Year 1 Oct. 2022 – Sep. 2023				Year 2 Oct. 2023 – Sep. 2024				Year 3 Oct. 2024 - Sep. 2025			
	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3
PROCUREMENT												
Supplies order												
Contracts/subawards issuance												
COMMUNITY NEEDS ASSESSMENT												
Survey IRB approval, design & distribution												
Listening sessions												
Focus groups												
Data compilation and analysis												
COMMUNITY STEERING COMMITTEE												
Members recruitment and selection												
Regular meetings (progress evaluation, refinement of study, discussion of data collection & presentation, mitigation action)												
SENSORS												
Pre-deployment lab calibration												
Field correction factors												
Host recruitment and selection												
Field deployment/hands-on training												
Data collection												
DATA VISUALIZATION												
Adding PM ₁₀ to map												
Adding map overlays (wind vectors, wildfire event locations)												
Sensor Measurements VALIDATION AND ANALYSIS												
Sensor QA/QC												
PM _{2.5} /PM ₁₀ maps validation												
OUTREACH ACTIVITIES AND RESULTS DISSEMINATION												
Educational /outreach material development												
Participation in community events, community presentations, school outreach												
Results dissemination												
Progress reports												

*Final report will be submitted 120 days after project completion, as stated in the RFA

Section 5 - Quality Assurance Statement (attached).

Section 6 - Programmatic Capability and Past Performance

A. Past Performance

UDAQ has a history of obtaining and successfully completing grants. It has received many EPA grants, including three Community-Scale Air Toxics Ambient Monitoring (CSATAM) grants, two of which were awarded to Dr. Daher, PI on API-SLV. Awards include: 2015 CSATAM (XA-96834601) to monitor air toxics in West Valley, UT; 2018 CSATAM (XA-968770-01) to evaluate low-cost continuous formaldehyde sensors; and 2020 CSATAM (XA-96861401) to conduct ambient monitoring and health risk assessment of ethylene oxide from sterilization facilities.

B. Reporting Requirements

The first two CSATAM projects were successfully managed and completed, meeting all expected outputs and outcomes. Any deviations from the proposed project plan were documented and discussed with the EPA Grant Specialist. UDAQ submitted reports (including final) in a timely

manner and met expectations. The more recent CSATAM project is currently underway. Quarterly progress report deadlines are being met. Progress update meetings are regularly scheduled with the assigned grant officer. More frequent communication is also initiated, as needed.

C. Staff Expertise

Dr. Nancy Daher will oversee the progress of the project and fulfillment of the grant requirements. She is an air quality researcher at UDAQ and an adjunct professor in Occupational and Environmental Health at the UU. Through her active participation in several air quality monitoring and modeling studies in the SLV, she has a strong understanding of air pollution emission sources and challenges in the valley. She also has experience with community outreach through her work on CSATAM grant awards. Dr. Kerry Kelly will lead the UU efforts. She is an associate professor of Chemical Engineering at UU and has collaborated with Dr. Daher, Collins, and Grineski³. She co-developed the AirU sensor and has published numerous peer-reviewed papers on the evaluation and assimilation of low-cost PM measurements^{4,6-8}. She actively participates in the translation of science to air-quality policy through her service Utah's Air Quality Board, UCAIR's Board, and Breathe Utah's Board. Drs. Sara Grineski and Tim Collins will collaborate with Dr. Kelly on the survey. Dr. Grineski is a professor of sociology with a shared appointment in environmental and sustainability studies (ENVST). Dr. Collins is a professor of geography with a shared appointment in ENVST. In addition to conducting national-scale environmental justice research, they have collaborated on several quantitative environmental justice publications on air quality in Salt Lake (including one with Dr. Kelly³) and have extensive experience with social survey research methods. Both serve on the Board of Scientific Counselors to the USEPA.

Section 7 - Budget

A. Budget Detail

Table 4. Detailed budget.

Itemized Cost	EPA Funding		
	Estimated Hours	Hourly Rate	Cost
Personnel			
Scientist IV @ 38.07\$/hr x 130 hrs/year x 3 years	390	\$38.07	\$14,847
TOTAL PERSONNEL			\$14,847
Fringe Benefits	Rate	Base Amount	Cost
TOTAL FRINGE	58%	\$14,847	\$8,611
Travel	Rate/mile	Total Miles	Cost
In-State Travel to sampling sites/community events @ \$0.38/mi x 2500 mi	0.38	2500	\$950
TOTAL TRAVEL			\$950
Supplies	Cost Per Unit	# of Units	Cost
Tablets (for surveys, listening sessions...)	\$500	4	\$2,000
Participant Support Costs (stipends, incentives)			\$25,400
TOTAL SUPPLIES			\$27,400
Contractual		Cost	
Contract with Tellus inc. for sensors, automated QA, map visualizations, providing back-end support for sensor network, developing air quality alert system. See attached budget (Tellus_Budget.pdf)		\$55,727	
TOTAL CONTRACTUAL		\$55,727	
Other		Cost	
Subaward to the University of Utah for survey services (inc. translation), sensor calibration & deployment, data QA & analysis, outreach activities, managing project website & air quality alert notifications. Attached budget (UU_Budget.pdf).		\$131,676	
Subaward to Utah Clean Cities for community outreach & engagement activities. Attached budget (UCC_Budget.pdf).		\$25,000	
Subaward to Friends of the Great Salt Lake for outreach & community engagement activities. Attached budget (FRIENDS_Budget.pdf)		\$16,950	
Phones, building/site rental, LAN, building utilities, printing/photocopying		\$1,220	
TOTAL OTHER		\$174,846	
TOTAL DIRECT COSTS			\$282,381
Indirect Charges	Rate	Base Amount	Cost
TOTAL INDIRECT	12.78%	\$23,458.0	\$2,998
TOTAL FUNDING			\$285,379
TOTAL PROJECT COST			\$285,379

Scientist IV (ND) will oversee the project, facilitate sensor field calibration, participate in community outreach/engagement activities, sensor siting and data QA. The contract with Tellus Inc. includes costs for sensors, adding the Alphasense OPC-N3 sensor to the AirU platform, developing maps for PM₁₀, adding wind direction and wildfires overlays to the maps, providing back-end support for the sensor network and automated QA, and developing the air quality alerts. “Other” costs include subawards to UCC and FRIENDS, which include costs for conducting listening sessions/focus groups, co-developing educational materials, conducting outreach and engagement activities. A subaward to the UU is also included under “Other”. It includes costs for calibrating and deploying sensors, participating in community engagement activities, including developing activities that can be used in schools and community events, as well as costs for analyzing air quality data, performing QA, and deploying and managing website and the air quality alert messaging system. Costs for developing and conducting an IRB-approved survey, and for translating the survey into Spanish are also included in the UU subaward. Supplies include costs for tablets and participant support costs for engagement activities. The latter include incentives for surveys at \$10/respondent x 700 respondents, committee and transportation stipends for residents serving on the community steering committee, estimated at 1300\$/person/year x 4 persons x 3 years. Other members will volunteer their time. Incentives for hosting sensors and participating in community events are included too. Supplies include costs for tablets to be used during engagement activities. 3 donated PA sensors (\$735), EPA EJ grant to UCC (\$75,000) and NSF grants used to develop the sensing and data integration infrastructure in the SLV (\$850,000) will be leveraged for this work.

B. Expenditure of Awarded Grant Funds

UDAQ will follow strict procedures and controls to ensure timely and efficient expenditure of funds. This includes setting up contracts/subawards that include specific tasks, timelines and fixed costs. UDAQ’s finance department and the PI will review detailed monthly grant expenditures to ensure that only supplies and services necessary for the project are purchased. They will also oversee all subawards and related expenditures to ensure compliance with applicable federal, state and local regulations and grant procurement policies and procedures.

References

- (1) McClure, C. D.; Jaffe, D. A. US Particulate Matter Air Quality Improves except in Wildfire-Prone Areas. *PNAS* **2018**, *115*, 7901–7906.
- (2) Perry, K. D.; Crosman, E. T.; Hoch, S. W. *Results of the Great Salt Lake Dust Plume Study (2016-2018)*; 2019.
- (3) Mullen, C.; et al. Patterns of Distributive Environmental Inequity under Different PM_{2.5} Air Pollution Scenarios for Salt Lake County Public Schools. *Environ. Res.* **2020**, *186*.
- (4) Kelly, K. E.; et al. Community-Based Measurements Reveal Unseen Differences during Air Pollution Episodes. *ES&T* **2021**, *55*, 120–128.
- (5) Mendoza, D.; et al. The TRAX Light-Rail Train Air Quality Observation Project. *Urban Science* **2019**, *3*, 108.
- (6) Kelly, K. E.; et al. Ambient and Laboratory Evaluation of a Low-Cost Particulate Matter Sensor. *Env. Poll.* **2017**, *221*, 491–500.
- (7) Becnel, T.; et al. A Distributed Low-Cost Pollution Monitoring Platform. *IEEE IoT Journal* **2019**, *6*, 10738–10748.
- (8) Sayahi, T.; et al Long-Term Field Evaluation of the Plantower PMS Low-Cost Particulate Matter Sensors. *Env. Poll.* **2019**, *245*, 932–940.
- (9) Kosmopoulos, G.; et al. Low-Cost Sensors for Measuring Airborne Particulate Matter: Field Evaluation and Calibration at a South-Eastern European Site. *STOTEN* **2020**, *748*, 141396.
- (10) Ouimette, J. R.; et al. Evaluating the PurpleAir Monitor as an Aerosol Light Scattering Instrument. *AMT* **2022**, *15*, 655–676.
- (11) Crilley, L. R.; et al. Evaluation of a Low-Cost Optical Particle Counter (Alphasense OPC-N2) for Ambient Air Monitoring. *AMT* **2018**, *11*, 709–720.
- (12) Sugimoto, N.; et al. A Method for Estimating the Fraction of Mineral Dust in Particulate Matter Using PM_{2.5}-to-PM₁₀ Ratios. *Particuology* **2016**, *28*, 114–120.
- (13) Mendoza, D. L.; et al. The Role of Structural Inequality on COVID-19 Incidence Rates at the Neighborhood Scale in Urban Areas. *COVID* **2021**, *1*, 186–202.